THE PRINCIPLES OF MEDICINE

AN INTRODUCTION

TO THE STUDY OF SPECIAL PATHOLOGY. A TEXT BOOK FOR STUDENTS; BEING A COURSE OF LECTURES DELIVERED TO THE CLASSES OF THE CLEVELAND UNIVERSITY OF MEDICINE AND SURGERY.

BY

E. R. EGGLESTON, M. D.,

PROFESSOR OF THEORY AND PRACTICE IN THE CLEVELAND UNIVERSITY OF MEDICINE AND SURGERY; LATE PROFESSOR IN THE HOMŒOPATHIC DEPARTMENT OF THE UNIVERSITY OF MICHIGAN.

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PREFATORY NOTE.

In view of the ripening time for the abolition of the didactic method of medical teaching and the substitution of the Text-Book, this little volume has been prepared for the use of the classes of the Cleveland University of Medicine and Surgery. It is brief and unpretentious, being in fact the condensation of a larger and completer work in course of preparation, but it is believed to cover mainly, even if too briefly, the essentials of this most important field of study. It is intended, as the title indicates, as an Introductory Course, and therefore for Junior students, and was originally written for and delivered to them; but it is hoped that those of "a larger growth" may find some profit in its pages. While former students may be gratified upon its publication, as they have so urgently desired; and present ones gratified because relieved of a part of their lecture-room drudgery; the gratification of the author is with the step forward from the old good to the new better methods of teaching—better, because more comprehensive and exact. So far as it may fill such a place, let it stand until a better mind and hand shall work out and write a better.

Due acknowledgement is made to the authors of the many great works named in the bibliography at the end of the volume.

E. R. E.

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The Principles of Medicine.

I. INTRODUCTION.

Medicine, in its wide sense, includes everything pertaining to the knowledge and treatment of disease.

In a restricted sense, however, it does not include Surgery, Obstetrics and other special departments, because involving so many special principles and methods of practice, they are better taught and better learned if they stand independently; although it is to be understood that no antagonism exists between them, for what is true as a principle of Medicine is true with regard to a like thing as a principle of Surgery, or any other department.

The *Principles of Medicine* consist of the general facts and doctrines of disease, its causes, phenomena and treatment, which apply to groups or classes, or to disease as a whole. It is, therefore, distinguished from the Practice of Medicine, in that the latter consists of the special facts of diseases; that is, whatever pertains to individual cases of disease.

It is a *deductive* science, its deductions being based upon the facts of normal structure and function of the various parts of the body, as well as upon the facts of abnormal structure and function; and includes the conditions of both life and death—death of parts as well as of the whole.

It is a *relative* science, in that the phenomena of both health and disease demonstrate more or less completely the close relations existing between these and the phenomena of the external world.

It is thus that the works of sanitary science, and climatology, and meteorology, and bacteriology and others of like character, including every physical condition that goes to make up environment, have in great measure determined the character of the principles upon which the practice of medicine is based.

Through *sanitary science* the fact is recognized that environment, good, bad or indifferent, is a potent factor in the length of days and the prevalence and malignancy of scourges of disease, and the origin and predominance of diatheses.

In *climatology* similar facts are discerned, but of such broad scope and effect that whole nations may be embraced within their influences.

By reason of the *meteorology* of the day we know, because of the variable positions and conditions of the members of the solar system, that conditions upon our own planet must vary accordingly, and

from experience we learn that such variations may be frequent and extreme. These perturbations manifest themselves through electric tension, excess or deficiency of atmospheric gases and other constituents, atmospheric pressure, humidity, and all properties and qualities and quantities that go to make up the grand mean which we call environment.

Epidemiology is no longer a wholly sealed book. True, we do not yet know the essential nature and origin of the toxic principle that gives the characteristics of the epidemic or contagious diseases; but being familiar with their phenomena and in large part the conditions under which they act, we must soon discover their essential nature. It is even now certain that qualities external to the body and essentially antagonistic to it, and those internal and of the body, also antagonistic to it, are both factors of the problem, and that certain relations of these, as of cause and effect, appear in every epidemic of disease.

Bacteriology is the connecting link between the conditions of physical and dynamic environment on the one hand and the organic and vital conditions of the living animal body on the other. It may be accepted as true thus far: that so long as the tissues preserve their normal vigor, so long they are obnoxious to either animal or vegetable micro-organisms—except in cases where they act as vehicles for

the transmission of septic substances; but once the tissues are degraded, by either external or internal influences, they therefore become a nidus for the operations of these microscopic forms of life. They are, therefore, in a vast majority of cases, mere conservators. In this way nature provides for the removal of degraded or devitalized material. In the other cases alluded to, where the organisms transmit septic substances the character of which is unknown, it is only that they are actual carriers of a specific virus that they cause disease, because they have been propagated in a tissue of like kind, and not from any quality peculiar to themselves. Why peculiar organisms are constant signs of particular lesions is easily explained in the fact that particular lesions invite peculiar organisms;—than which no physical fact is more clearly recognized and established. It is not too much to say that their importance as exclusive etiological factors has been very greatly over-estimated, and that it is more and more clearly recognized that they are but one of many factors, the sum of which stands in a causative relation to morbid conditions.

Closely related to bacteriology, and what in reality in large part determines its established value, is *Auto-intoxication.* To some extent recognized for a long time, it is only of late years that it has assumed a commanding position. It is a necessary sequel to studies in physiological chemistry, and supplements

the weaknesses while it refutes the absurdities of the germ-theory of disease. The importance of this matter is well indicated in a few words from Lauder Brunton: "Chemical investigation has shown how disease depends upon the products of fermentation and putrefaction rather than upon the direct action of microbes upon the tissues."

Thus, item after item of all facts and possibilities that may have any relation to the morbid conditions of human organisms are taken cognizance of and adapted to the needs of practical medicine. We have, then, undertaken a growing science, one that will so continue.

The adverse criticisms so freely showered upon it, that it is a mere assemblage of shifting opinions, unreliable, and, therefore, unworthy of confidence, are ill-advised and mistaken. Nothing under the shining sun is more sure than the vast array of principles which have been evolved from the best thought and investigation and experience of the world up to this time, which forms the body of this grand department of medical science; nor can anything be more sure than that the same mature judgment and experience will sift and weigh and estimate the true value of the hypotheses and theories of this day, to be finally accepted or rejected according as they stand or fall by the tests that science and experience may demand.

II. DEFINITIONS.

The *Science of Medicine* naturally divides itself into two departments, Pathology and Therapeutics.

Pathology relates to the study of the phenomena of disease during life, in general and particular.

General Pathology comprises the natural history of diseases. It treats of their nature, their origin or causes, their phenomena, the seats they occupy, their progress and their terminations.

Special Pathology treats of conditions which characterize diseases singly, or in classes limited by peculiarities common to all of that class.

Therapeutics is the science and art of healing by medicinal means. It is the use of medicinal substances for the cure of disease according to some method which is based among the natural as well as the medical sciences, and which is justified by experience.

It is here that we come upon the first fact in that great complex we call *therapeutics*. It is clearly reasonable that the remedy cannot be such in a scientific sense until it has related itself with the other factors of the given case; that is, the causes, symptoms, results and the remedy must bear definable relations with each other. It appears, therefore, that, strive he never so hard, the homoeopathist cannot

divest his practice of its pathological basis. Every cause, symptom and condition is but part of a pathological totality, and, therefore, of a remedial totality. And, ignore he never so vehemently the aid of pathology, its principles form the basis of every diagnostic and prognostic and curative estimate by every educated practitioner the world over. This is what I would impress upon you: *That a complete working symptomatology is only possible side by side with a complete working pathology.*

III. DISEASE.

Physiology teaches that certain structures and functions are definitely related to each other, and that when all the conditions of this relation are fulfilled and are permanent, there is a state of the body called *health.*

Disease is a deviation from the state of health. That is, the nice relation of function to organ is disturbed—it deviates from the normal. Whether of brain, or heart, or stomach, or uterus, it is equally true that a just proportion of organic force to function, its full supply and proper expenditure, represents health; and an unjust proportion, of supply or expenditure, stands for disease. It is, however, a relative term, for there being no absolutely fixed

standard to be called health, there can be no absolutely fixed standard to be called disease. Every individual, depending upon the temperament, environment, habits of life, diathesis and the like, has a standard of his own, departures from which constitute disease in that individual. So limited it may be said that *all variations from the regular or typical condition of structure and function which cause suffering or endanger life; and all irregularities, whether of structure or function, progressive and tending to cause suffering or danger, constitute disease.*

There are, however, abnormal conditions, simple deviations from normal standards, which do not imply disease. Among these are structural defects, as deficiency, redundancy, or distortion of parts; and, again, there may be defect or intensity of faculty or function, and yet, lacking the qualification of tendency to injurious and increasingly evil consequences, they are not diseases.

For example, let the average pulse of an adult be set down at 70-80, in numbers of individuals it may be found at 90-100, or as low as 40-50, they being healthy. And so on with alimentation, muscular activities, nervous qualities, heredities and acquirements, there is a very wide range of variation, and yet individuals at either extreme may be healthy. All such deviations may, however, remain as so many proclivities or

predispositions to particular forms of disease. For instance, a nutrition fault, say sub-oxidation, well borne by some, may under the characteristics of others take the form of pathological obesity, rachitis, gout, diabetes, scrofula, or tuberculosis; or one possessed of vigorous fibre and high vitality is thereby predisposed to acute inflammatory affections, while another of easily degraded fibre and low vitality is predisposed to auto-infections and tissue degenerations.

Our use of terms may imply that diseases are entities; that existing apart from the individual some accident or indiscretion invites an attack upon him. It is a mistake. Diseases are named for convenience only. They are modes or conditions of life, and we name various assemblages of conditions from salient features or prominent symptoms, and thus indicate what transpires under certain conditions. In any case the name indicates the change taking place and no more.

In many cases there is such a concurrence of the elements of disease, both on the part of the body and external possibilities, that the form and substance of organs and tissues are changed; these are called *Organic diseases.* They rest upon an anatomical basis, and are recognizable by the ordinary means of observation. If the morbid changes may not be detected by eye or microscope, they are said to be

Functional diseases. The coarser anatomical changes which occur in the course of diseases are called *lesions.* Thus we recognize functional disease by deviation from a physiological standard, and organic disease by deviation from an anatomical standard.

All branches of the profession admit more or less completely the *physiological basis of disease;* that is, that no pathological process introduces any new element or process into the organism, but, instead, every pathological expression is but a variation of some existing physiological process. To explain the various phenomena in the sick and their relations is done through a knowledge of similar processes in the healthy body, and the study of morbid processes by all the methods which are used in physiology for the investigation of the functions of the normal body. This is physiological medicine.

The correctness of the attempt to construct pathology upon a physiological basis depends upon two considerations: First, "it is necessary to maintain the elementary notion that morbid processes do not essentially differ from normal ones; each morbid manifestation finds its analogue in physiological conditions and processes. There are no specific chemico-pathological bodies. Leucin and tyrosin, which were looked upon as the cause of the nervous symptoms in atrophy of the liver, were soon proven to be usual constituents of the healthy body." Second,

"there are no specific pathological forms. It was believed awhile ago that peculiarly formed cells could be said to exist in tubercle, sarcoma, cancer, a statement which has been shown to be false. There is no radical difference between the forces and the substances by means of which normal and morbid life is kept up; no important difference between physiological and pathological laws. The difference lies in the conditions under which the forces and substances of the body operate. *The development deviating from the destined aim is the pathological process*" (*Henlé.*)

Giving this statement a moment's thought, we are struck with the exact parallel between it and medication under the law of similars. For what other is a *proving* than a methodical statement of variations of physiological processes and the morbid anatomical conditions which succeed them? Need the fact be emphasized that such a basis furnishes the *only* reliable one for an unimpeachable symptomatology, because they are the only *constant* expressions of like conditions.

Diseases are also *local* and *general.* Some are manifestly local; others apparently local—that is, while apparently local they may express general disease. A gastric irritation from a known local irritant is purely and simply local in every sign and symptom; but if from an unknown or remote cause,

it may be related with general or other local disease, while apparently localized in the stomach. Cerebral and uterine diseases frequently give rise to apparently local disorders in other organs. General disease may involve many organs and tissues, or give rise to apparent local disease. Nothing is more common than the radiation or diffusion of disease from a certain seat; while we every day have to treat the local manifestations of general morbid states of constitution or diathesis.

Primary local disease extends in three ways: by contiguity and continuity of structures; through blood and lymph, and through organs and tissues whose structures and functions are of like kind.

Instances of extension by these ways are common. Catarrhal inflammation of the mucous lining of the nares frequently involves *by continuity* the frontal sinuses, antrum of Highmore, the middle ear through the Eustachian tubes, the faucial, laryngeal, tracheal and bronchial surfaces. Inflammation of lungs, stomach and intestines, of uterine and urinary organs, and of the liver, not infrequently involves their serous investments *by contiguity*. *Through blood and lymph* may be conveyed to all parts of the body a great variety of substances, toxic or accidental. They range from mere mechanical transmission of substances, as of coagula, to habitual transmission of fluids of abnormal composition or

impregnated with poisonous matters, which may give rise to disease in distant parts or the whole of the body. Bones, joints, serous and connective tissues and the skin furnish examples of extension *through tissues of like kind and function.*

IV. THE NATURE OF DISEASE.

Henlé, who wrote forty years ago, insisted upon the idea that *force* is the fundamental fact of all normal and abnormal conditions, and that disease is only the exhibition of abnormal force. Having established the fact that "relative normality is that form which the typical force represents under the usual conditions," he says: "Disease is the departure from this relative normality; but the nature of disease is the manifestation of the typical force under unusual conditions. We find that the matter of animal bodies is in constant fluxion; that the loss and renewal of substance is a fundamental character of the living. It is not singular that this fundamental feature should be preserved under extraordinary influences. Only as long as it maintains itself is the individual sick; an alteration which completely annihilates it, occasions not disease, but death. Disease, therefore, is a process, because life is a process; if it belongs to the type of a body, to change its form

or substance, then abnormal influences change it not only for the instant but they change its mode of transforming itself; according to the duration of their effect they divert it, for a longer or shorter time, or forever, from the object for which it was destined. The *development* deviating from the destined *aim* is the *pathological process.*"

Speaking of the nature of the actual disturbances in the body, Payne, in his General Pathology, says : " They are the resultant of three kinds of forces: the injury, the initial impulse of life which determines growth, and the molecular forces produced by the materials of the body itself, when acted upon by all the surrounding circumstances, such as air, food, temperature, which set up in them chemical and physical changes. If this be the case, it follows that the processes of disease are the same as the processes of life, *plus* the injury. We may go further and say that they are merely the processes of life differently combined and arranged in a different order. Strictly speaking, diseases are natural processes so combined as to produce a course of action in the body which is not natural."

So pathologists of the earlier and later times are in very close agreement.

Without going into a discussion of this most interesting subject, for which this is neither the time nor place, let the following stand as a present conclu-

sion: The effect of any atypical force upon a like force of the body may so derange the total that organic change or disease is the result; or the action upon the tissues of the body, of forces palpable or impalpable, may so disorder their construction and alter their functions that as a result all developmental processes are deranged.

V. ETIOLOGY—THE CAUSES OF DISEASE.

"After having devoted herself for many long years to the verification of symptoms, to the research of anatomical lesions, the study of pathological physiology, medicine comes at last to the study of the organ of disease. What is characteristic of these modern days is the high place we assign to the study of etiology." (*Bouchard.*)

Disease is never spontaneous; it always arises from a cause. There is a tendency on the part of the body to perform its functions normally unless interfered with in whole or part by causes external to it or of internal origin. The natural phenomena of the body, while undisturbed by causes from within or from without, are results of the unembarrassed co-operation of all the typical forces that go to make up development. That they may be changed from

either direction, by abnormal distribution, by fluctuations and by unusual combinations, and that they may be material or immaterial, is apparent.

There is a fact regarding the external forces that we are apt to lose sight of. Being constantly in contact with them, however antagonistic the contact may be, we yet forget that it is *only to a mean of these forces that the body is conditioned.* It follows, therefore, that extremes of either, of excess, deficiency, or perversion, must become prolific sources of abnormal relations with the operations of the body which depend upon them. What we recognize as disease is the result. The point never to be lost sight of is that every such condition, at mean or extreme, produces an effect upon the internal phenomena of the body, normal or abnormal. The immensely numerous differentiations that occur in the animal body demonstrate its numerous points of contact with forces external to its organization; and as differentiations become more numerous, so do opportunities for injurious influences accumulate.

Another matter of considerable consequence is, that while nature furnishes the materials requisite to the development of the body, but very few of the substances are in kind or quality suitable without change to be appropriated. They exist in combinations which must be broken up, or are solitary and must be combined before being made part of the

living organism. Excesses must be carried off by excessive action in one direction, and deficiencies supplemented by excessive action in another direction. Supplies from vitiated sources, of abnormal quality, or extraneous matters foreign to the purposes of the organism, must be neutralized or eliminated.

Thus we speak of *extrinsic causes*, including all external conditions which transiently or permanently act upon the body in a deleterious manner, such as all varieties of miasmatic and infectious poisons; all meteorological fluctuations, as of temperature, atmospheric pressure, electric tension, ozone, noxious gases, climate, and the like; and all effects of substances and properties of extraneous matters, solid or gaseous.

We speak also of *intrinsic causes*, including all conditions of blood and tissue which represent degenerative changes with retention of products.

General causes pertain to hereditary, constitutional or diathetic conditions; to nationality, sex, age, and occupation.

Special causes include only those strictly specific which have constant results; such as induce cholera, influenza, and the specific fevers.

The extrinsic causes must, therefore, be almost without number. For, as the body is conditioned to the mean of its environment, departures from that

mean of any force is a new condition that must be accommodated; and thus resistance is too neavily involved, which is a first step in the process of disease.

Meteorological conditions are among the most important of these.

Electric tension is a quality of all living bodies. It possesses a certain normal mean, but is exceedingly variable, being at times too high, and again too low, either of which is unhealthful. High tension electricity is a stimulant and may become an irritant. Thus the condition tends to hyperaesthenic inflammatory affections. Low tension electricity is a depressant; therefore, the low types of diseases characterize the condition.

That *atmospheric pressure* exerts an influence upon animal life is a matter of common observation. Ascent into high altitudes shows the bad effects of increasing low pressure chiefly in abnormal vascular conditions; while physical and mental degeneracy characterize dwellers below the sea-level. It is not uncommon to meet with barometrical fluctuations of one inch; and if we remember that this is one-thirtieth of the total weight of the atmosphere, we may easily believe that so great a change may be deleterious.

Ozone is the allotropic form of oxygen, "a form in which the element itself is so changed as to have

new properties." It is evolved under the action of free atmospheric electricity. Therefore, if there is little or no free electricity in the air then little or no metamorphosis of oxygen takes place. "It is nature's great disinfectant and deodorizer, uniting most readily with the gases which arise from decaying animal and vegetable matters, and by depriving them of their noxious qualities serves to purify the air. Its importance arises from its intense activity rather than its amount, for the maximum quantity never exceeds 1-700,000 of the volume of the air." Boeckel concludes that "ozone in normal quantity produces no pathological phenomena on the healthy. In excess it affects the respiratory organs, inducing bronchitis; when deficient gastric diseases prevail." It is readily absorbed by the blood, in which it liberates oxygen, and so elevates in the scale of oxidation the chemical products of retrograde metamorphosis, as to render them more facile of elimination. Therefore, when there is excess of ozone diseases of exalted type prevail, and when deficient those of depression.

Carbonic acid is furnished by all kinds of combustion, by all air-breathing animals, by decomposing animal and vegetable substances, and by chemical action. Our present interest in it arises chiefly in the fact of the facility with which it unites with hydrogen, forming compounds known as hydrocar-

bons. Instead of union with oxygen to form an oxide or anhydride, an atom of carbon unites with four atoms of hydrogen, becoming the light carburetted hydrogen, or marsh-gas. This transformation takes place freely in swamps and low marshy places in consequence of the decomposition of vegetable matter, and continues through an homologous series, the marsh-gas series, all being hydrocarbons whose constant common difference is one atom of carbon and two atoms of hydrogen. This series, more or less complete, should be present in all situations where vegetable decomposition is going on rapidly, where there is excessive evolution of hydrogen and non-absorption of carbonic acid; and thus the latter becomes excessive. It seems superfluous to add that these are the common conditions of all malarious regions. Normal air contains about four parts per ten thousand, by volume, of carbonic acid. It has been found in the ground-air of similar localities as high as one hundred and seven parts per ten thousand.

Vapor of water is constantly present in the air, the amount varying from four to sixteen parts per thousand, according to temperature and pressure. It is a well-known fact that the power possessed by water of absorption and solution of both gaseous and solid materials is something enormous. Gases evolved by decomposition of matter on or in the

earth are rapidly taken up and diffused by the atmosphere, more so the more free it is of watery vapor, and less so the more water it contains; in the latter case because the vapor dissolves and holds the gas, and its specific gravity being greater, it can not be so widely diffused. The consequence is that the residues of decomposition are held near the surface of the earth; are localized; will occupy, fill, and overflow the borders of depressions on the surface, as in valleys, all on account of the power of vaporized water to imprison such substances, the greater specific gravity of the loaded atmosphere which holds them down, and the withdrawal or weakness of the only force which can overcome gravitation and disperse them—the heat of the sun. These, again, are essentials of malarial fever, and undoubtedly aid in the spread or delimitation of other infectious diseases.

There are some *geological conditions* that should be mentioned in this connection. They are very similar to those just described.

Geologists describe three external layers: soil, sub-soil and bed-rock. Everywhere, without regard to quality, these layers contain air, gases, water, and organic matter, all of which are characterized by remarkable unstableness, depending upon such causes as variable temperature, atmospheric pressure, and organic and chemical decompositions.

Ground-air is continuous with the atmosphere and penetrates the earth to the variable zone of ground-water, and is a factor in nearly all of the decompositions which take place beneath the surface, its own character being of course changed. Oxygen disappears in the decay or oxidation of carbonaceous substances, entering into combination with carbon to form carbonic acid. In situations where organic decompositions are free and rapid, its evolution is enormous. According to observations at different seasons of the year, it is found in the proportions of three to more than one hundred parts per thousand, by volume. Its volume is greatest when decomposition is most rapid, and least when decomposition is slowest; that is to say, from July to October, when fevers of intermittent type present themselves, its quantity is by far the greatest. All these gaseous products make their way into the overlying air in greater or less quantities through the processes of exchange and expansion, and have an influence upon health, as already seen.

It is important to note the instrumentality of micro-organisms in these processes. They "promote the decomposition of dead matter." This fact should be emphasized, because the funtion as performed under such conditions is absolutely typical; typical not only here, but under every other condition where their operations form part of phenomena.

There is no reason to believe that the schizomycetic forms have a function other than this. That their propagation in living bodies is characteristic of them does not alter the criterion of their presence, for the *decomposition of dead matter* is their function here as in the other case.

The *intrinsic* causes are now mainly known as *auto-intoxications.* The true idea of self-poisoning is not comprehended only in the absorption of disease products, as in septicaemia and pyaemia, nor of poisonous materials from outside sources; but means the retention within the body, and therefore poisoning by, the products of metabolism—the products of abnormal chemical metamorphosis. Such abnormal chemism gives rise to a series of substances known as *alkaloids.* Some of these are pathological, some are pathogenic; some are poisonous, some inert.

They are also known as *ptomaines* and *leucomaines;* the first signifying basic chemical compounds resulting from the action of bacteria upon organic matter—the putrefactive or vegetable alkaloids; the other, basic substances, the result of tissue metabolism—the animal alkaloids. Putrefaction gives rise to a great many transition products which may be regarded as "temporary forms through which matter passes while it is being transformed by the activity of bacteria from the organic to the inorganic state" (*Vaughan*).

Bouchard has very successfully demonstrated "that, whether introduced into the system from without or resulting from perversion of metabolism, secretion, or elimination from within, these poisonous principles explain the origin and mechanism of much of what is called disease." He goes on to name four sources of auto-intoxication: "(1). An abnormal vital condition, defective nutrition, hereditary or acquired; (2) morbid effects of external causes—physical, mechanical or chemical; (3) complex processes, or any process complicated by reflexes; and (4) invasion of the economy by contagious or infectious elements."

He then continues: "Seeing the importance of the part played by disordered nutrition, nervous reaction, and putrefactive processes continually at work in the economy, we are confronted with the physico and biochemical processes of animal growth and decay, their chemical products, particularly those now known as ptomaines and leucomaines, and finally with the fact that in life, as in death, so-called aerobic and anaerobic processes co-exist, apart from, and irrespective of, bio-chemical interjectional activities. * * * Before every illness there is a disturbance in life,— for nutrition is life. What can bring about this disturbance,—the first step to be overcome before becoming ill? It may bring about a change in the production or distribution of the

forces which liberate certain substances elaborated by the living organism. It may modify the matter itself—augment or diminish it—whilst preserving the normal proportion, or it may bring about disproportion of the constituent elements; it may, in short, cause the appearance of abnormal substances through perversion of the changes associated with nutrition. From absolute increase of normal matter, or the production of abnormal, intoxication may be developed."

He speaks of the office of microbes in this connection, as follows: "The healthy man is not attractive to the microbe, but it is not thus with him when his vitality is weakened. It is then that certain microbes may invade the human organism, whose health breaks down, whenever, by the fact of diordered nutrition, the chemical constitution is modified. It is, therefore, a modification antecedent to nutrition which renders infection possible. Disease is thus the result of two different processes, one of which can only act by means of the other."

VI. ETIOLOGY—PREDISPOSING CAUSES.

Predisposing causes are such as determine or influence the organs of the body or their functions, so as to render them susceptible to the operation of causes, or obnoxious to them.

The principal predisposing causes are:—

1. Depressing or debilitating influences.
2. Excitement or exaltation.
3. Results of previous or present disease.
4. Heredity.
5. Temperament.
6. Age.
7. Sex.
8. Occupation.

To consider these briefly:—

1. *Exciting* and *depressing causes* are very numerous. It is not always easy to say which is immediately responsible for the symptoms, for the heart, arteries, nervous system, and secretory organs yield the signs of excitement, and the same organs and systems give the indications of depression. Thus previous circumstances must determine the question.

Over-full living without adequate exercise; violent exertion; over-stimulation of any organ or function; long continued use of one part, as of brain or muscle; all are sources of excitement, all are sources of depression, either of which may become pathological or induce susceptibility to other external or internal causes. The periodical hyperaemia of uterus and mammae render these organs liable to diseases of inflammatory character; violent and long-continued use of muscles in cold, damp places

induces rheumatism; over-indulgence in alcoholic beverages, while having stages of excitement and depression, is followed by organic diseases of brain, heart, liver and kidneys; and so on through a long list.

Some of those that are essentially depressing are the following: *Imperfect food*, quantity or quality; *impure air*, as in over-crowded dwellings, sick rooms, malarial and epidemic atmospheres; *excessive exercise of body or mind*, as pushing either to great tasks or over great lengths of time without rest; and *loss of sleep*.

Sedentary habits are prolific sources of debility. Activity is the pre-requisite of vigor. With such habits diseases of muscles, brain, heart, lungs and digestive organs may be results of defective assimilation, imperfect respiration and sluggish circulation of blood heavily charged with imperfectly oxidized material.

Protracted exposure to heat and cold. The relaxing and debilitating effects of heat are well known. All muscular structures, including heart and arteries, lose tone and power; all bodily textures are relaxed; liver and other internal organs from early stimulation pass into torpor and relaxation, and thus arises the predisposition to the so-called bilious and summer complaints. Less oxygen is taken up during high than during low temperatures, by reason of

less respiratory effort, and thus effete products are less completely oxydized or eliminated.

Cold is a sedative. Applied for a short time it invigorates because it induces vigorous reaction; but applied for a long time or in excess, reaction is absent and depression continually deepens, directly lowering all vital activity. The superficial circulation is slowed or ceases, the blood being crowded upon internal organs.

Alternations of heat and cold, especially if sudden or extreme, are quite as important as excess of either.

Alcoholism is not only predisposing, but is a direct and fertile source of a host of disorders, tending directly to those of inflammatory character, with decided leaning to degeneration, and hardly less so to diseases of brain, heart, stomach, liver, kidneys and blood, which resist all efforts for their cure. It so depraves and debilitates the tissues that surgical procedures and accidents whose effects are otherwise curable, become fatal; and illnesses of trifling or moderate severity run speedily to fatal terminations.

Depressing emotions, such as fear, grief, anxiety, despondency, are debilitating, and thus break down the power of resistance to morbid influences. Timid and fearful persons are more apt to fall victims to epidemics than are the brave and reckless; more sickness prevails among soldiers after a defeat than

after a victory. Confidence and courage reinforce resistance, while fear and uncertainty weaken it.

Excessive losses of the fluids of the body, or persistent small losses induce debility of exceedingly obstinate character.

It is important to remember in this connection that there are constitutional or transmitted conditions of the organism which, present at birth, or depending on age or stage of development for conditions on which to establish themselves, may be untimely precipitated by the operation of any of the foregoing predisposing causes. Such diatheses all refer to defective organization or lack of organic or dynamic balance, and while they may remain latent until the time for their appearance has fully come, they may be brought to premature development by such circumstances.

2. *Results of previous disease.* A few instances may suffice: Croup, enteritis, convulsive disorders, such as epilepsy, chorea and hysteria, are very liable to recur. In such cases the body takes on pathological habits, and the longer they have continued the more difficult is their cure. It is probable that in most of such cases some tissue change has been set up that is not discovered. In another class of cases, such as rheumatism, gout, gravel and others, artificial deposits become sources of repeated irritation.

3. *Heredity* signifies the transmission from

parent to offspring of certain qualities or tendencies. It is *direct* when paternal or maternal moral or physical characteristics are transmitted; *collateral*, when such qualities descend to nephew or neice from uncle, grand-uncle, aunt or grand-aunt; *evolutionary*, when the foetus, during its development, is influenced by extraneous or physical impressions made upon the mother; *morbid*, in the transmission of disease, or tendency to it, from parent to child, such as neuroses, constitutional diseases, and psychological qualities.

The diseases most commonly the subjects of hereditary transmission are said to be: tuberculosis, scrofulosis, carcinoma, gout, rachitis, epilepsy and insanity. The first two are those most frequently transmitted apparently identical with the original. The others are as truly hereditary predispositions, but they are more readily neutralized or diverted.

It is an interesting fact that diseases to which subjects are predisposed through hereditary influences become active at an age corresponding with the same occurrences in progenitors. It appears to be explained in this way: The total of the forces with which the individual is originally endowed seems to have the ability to maintain a degree of health to no more than a certain distance along the road of life, or until the stress of exigencies, physical and physiological, overtaxes the powers of resist-

ance. Then the normal tendency gives way, to be replaced by the abnormal tendency.

Another important fact is that the hereditary tendencies that reappear in identical forms are those of nutrition types. Tubercle, scrofula, and rachitis are pre-eminently of this nature, and that they reappear at like periods of life is also a matter of common observation. The neuroses, especially, are prone to show great diversity when transmitted; and the circulatory, digestive and excretory systems manifest the same characteristics.

It is important to remember that if the individual predisposed to tuberculosis still dwells in a locality the conditions of which operate in the same direction as his inheritance, producing depraved metabolism, which, indeed, may originate tubercular deposits in an otherwise healthy subject, he only intensifies and insures that which favorable conditions might have averted. It is the same with other inheritances, the same conditions render certain what might under other conditions be avoided. Therefore, for those predisposed to tubercle, scrofula, rickets, gout, diabetes, and others, early radical change of conditions is the one all-important essential element of cure.

4. *Diathesis.* The term is so used as to include *temperament*, which includes nothing pathological, but is a phase of the organism expressing the pre-

dominance of one or other fundamental proclivity. The fact of such predominance may determine future diseases, but in no other sense is it pathological. But *diathesis* carries with it the distinct sense of pathological change. The character of the change includes the predetermination of temperament plus the specific effect of the cause which operates upon it.

Diathesis is a condition existing within bodies whereby they become susceptible, through a constant avenue, to the operation of causes. It is a constitution by inheritance.

Liability to contract certain diseases may be traced to hereditary transmission, or may be acquired. These may remain latent, without symptoms, until some later period of physical or physiological life; or be manifested from birth. In the first case the diathesis as certainly exists as in the other, lacking only some profoundly disturbing element which shall persistently disorder the balance of nutrition. Inherited tuberculosis is a familiar example. The conditions existing, but in latent form, at a later period of life, as at puberty, corresponding with profound physiological change, or when prolonged stress shall overtax resistance and recuperation, the disease breaks out. Other examples are: rachitis, gout, cancer, insanity, in either of which, up to a certain period of life, no trace of the disease or premonition of it may be discoverable.

Cachexia, a constitution by acquisition, is by common consent restricted to the protracted or chronic results of specific causes, such as poisoning by metals and quinine; and of some constitutional diseases, such as syphilis, cancer, malaria, and the like. In all there is the pallor of anaemia because the normal evolution of red corpuscles is prevented. The distinctions of pallor depend upon the kind of cachexia: In chlorosis it is greenish; in visceral cirrhosis it is like discolored parchment; sometimes the same in syphilis; in cancer it is yellowish; in disease of the suprarenal capsules—Addison's disease—it is of a bronze color; a peculiar flush of the face is found in disease of the right heart, while a livid pallor indicates disease of the left heart.

In both diathesis and cachexia it is beyond question that a large degree of *immunity* is gained by reason of such conditions, whereby the organism becomes obnoxious to and repels the invasion of otherwise potent causes.

There is another class of acquired predispositions that may be termed *normal*; that is, by reason of some special or physiological requirement, temporary, permanent, or periodical, an organ may take on susceptibility to agencies not otherwise harmful. Among such are ovulation, menstruation, lactation, and the climacteric. Besides, the stages of development, as ages of life; race, temperament, environ-

ment, and kindred qualifications, all in a manner predispose to disease.

Temperament is a habit of body—not necessarily a *bad* habit. It is an inherited constitution, and betrays itself in the physique, and times over it will prove the key to the malady presented for treatment. This is commonly true of chronic diseases, but even in the acute its consideration can not be neglected.

The *sanguine*, *gouty*, or *arthritic*, presents good bony development, firm muscles, and generally robust appearance. Digestion and nutrition are good; heart strong, pulse full and steady; respiration full and deep; skin florid, easily excited to perspiration, and is very sensitive. Such persons are liable to acute inflammatory and vascular diseases.

The *phlegmatic*, *lymphatic*, or *strumous* is a less clear type. Perhaps it most frequently decidedly tends to or is actually pathological, hence to that extent is diathetic. The bones of the strumous are not well developed; the epipheses are enlarged, and the joints appear large, especially of the hands and feet. The thorax is small and has small expansion, or it may be exaggerated. A high, prominent forehead, long eye-lashes, early carious teeth, full lips and broad nostrils, light, fine, thin hair, and a white, fine, thin, easily perspiring skin, complete the picture. Disorders common to this constitution are, in childhood: rickets, hip-joint, vertebral, and other

bone diseases; large liver, mesenteric and cervical glands, and acute tuberculous affections, especially of the meninges. In adult life pulmonary tuberculosis is prominent. Defective nutrition is the primary factor in this whole range of diseases; while in those acute it is often the stubbornest fact with which we have to deal.

The lymphatic proper is a positive antithesis of the nervous. While usually large, these persons are not strong, and endurance and resistance are minimal. The bones are large, but the muscles are small and lack firmness. Sometimes florid, and if under excitement, active, they are usually pale, and require stimulating food and drink to spur them to ordinary activity. They bear all sorts of depressing influences badly, and run into conditions of prostration very easily, and as a rule convalesce slowly. This temperament very frequently blends with the strumous, and thus its disorders are very generally marked by defective nutrition.

The *nervous* is characteristic of persons of slight and spare build; with small strong bones, a high and well vaulted skull, clear-cut features, keen active eyes, and a highly-developed nervous system. In these latter days this type becomes more and more pronounced, and the disorders to which it is liable are very generally of corresponding character or are greatly modified by it. The family histories of these

cases are marked by various disorders of nervous type, such as neuralgias and epilepsy, dipsomania, and neuroses generally.

The *bilious* is a characteristic of dark, swarthy persons. The skin may be dry and harsh, or have a moist, greasy feel, and is exceedingly impressionable if the temperament is blended with the strumous, which is of frequent occurrence. If this type is blended with the nervous, there are found, for instance, the beautiful, vivacious woman and the great sufferer in one and the same person. In this class there is a great tendency to biliary disturbances.

It is, of course, understood that while these types are true, and thus furnish standards for diagnostic and prognostic estimates, it is still true that not very many constitutions are true to type. They blend in a great variety of ways and proportions, and yet careful observation may very generally detect predominance in one or other direction.

5. *Age.* There are three notable epochs in the life of an individual. The first is that of growth and development; the second, the period of full development; the third, that of degeneracy or decay. Each is characterized by diseases, or tendencies to them, peculiar to it, which is true of acquired as well as inherited diseases. The period of development presents several stages, each being peculiar.

In *infancy* the low thermal conditions predispose

to the bad effects of cold, with their catarrhs and visceral inflammations. The sensitive skin predisposes to various eruptions, and upon it are reflected irritations of internal organs and dyscrasiae. The alimentary canal, unused at birth, must set up its functions, endure the change at weaning, sustain experiments of ignorant mothers and overwise nurses, and further endure abuses so common in children. The brain, taking up the myriad impressions in the process of its special development, is excitable and excited, easily takes up reflexions of distant irritations, and hence the proclivity to brain complications, convulsions, hydrocephalus, and other signs of cerebral irritability.

In *childhood*, the period between infancy and puberty, the organism busies itself with tissue change, growth and development, and therefore nutrition in its widest sense, and the organs relating especially to it, is the salient feature of the period; so, as might be expected, diseases most prevalent are those affecting the assimilative systems. The nervous system, too, for reasons already given, is prone to still present its complications and diseases. Diathesis may manifest itself in infancy, but with far greater frequency in childhood, because as a rule in the latter there is more exposure and greater liability to stress.

The *period of puberty* has peculiar tendencies in both sexes, but especially in females, in whom the

menstrual function is being established. When fully set up this function has important nervous and vascular relations, and its normal operation is easily disturbed; then how much more so when at first the force to be expended in periodical ovulation and menstruation is preparing to expend itself in the visible equivalent of a bloody discharge. Nor should it be forgotten that at a variable time previous to the setting in of the function, say at the age of ten or twelve, a premonitory excitement or irritability of the generative organs occurs,—a time that may be the occasion of as much anxiety as that of menstruation itself. This usually subsides in the course of two or three months, when quiescence again obtains until menstruation itself appears.

This, far more than at any other period of life, is the opportunity for the outbreak of diseases to which predisposition has existed. A profound physiological change takes place which must not only be accommodated by the organism, but must be assimilated with it. If the nervous and nutritive forces are equal to the expenditure, all is well; if not, not. It is also true that some predispositions may now receive an everlasting quietus. It is as truly a critical age as any that appears in later life.

Scarcely less critical is the time that marks the *termination of growth.* Intelligence has been evolved; motor, sensory, and reflex nerve systems have

gained the marvelous faculty of automatism, as well as the highest power of transmission; the musculature has reached its height of manipulative and coordinating ability; the nutritive forces and mechanisms can attain no higher ability than to perfectly divide and assort and absorb and appropriate substances useful to the development and perpetuation of the organism, and the removal or transformation of residues no longer useful or hurtful. Now nothing further is expended in growth. What is to become of it? In normal conditions it is conserved in what we know as resistance, endurance, vigor; is transformed to what we know as intellectual power, physical strength, and mechanical skill.

Predisposition takes one of three directions at this age; all conversions and conservations are properly done and the individual enters upon his greatest capacities in full health and vigor; or the force declines when demand for its activity ceases, and thus the individual declines, or some diathesis of degenerative type finds the suitable conditions for its peculiar development, whether of morbid deposits, of which tubercle is the common type, or of simple degeneration; or, lastly, if there is redundancy of the force the subject of it may become the victim of hypertrophy, hemorrhage, or inflammation.

Adult life does not predispose to disease because the forces are at equilibrium. Demand and supply

depend upon expenditure and waste, and one equals the other. Exposure, excesses, non-use and bad habits are responsible for most of the diseases of this age.

Old age. The predispositions of this period depend almost solely upon anatomical and physiological modifications which occur as a result of age. In some cases the changes may attain such extent that the physiological seems to have passed over into the pathological, or lie on the boundary line. Our attention is first arrested by external appearances. The dry, wrinkled, flabby, bloodless skin; the toothless mouth; the thin gray hair; the stooping decrepit figure; diminished weight and stature; all correspond to a general atrophy. These changes in the textures of the body appear to be induced by a retrograde movement of the blood-making organs, by alterations of vascular relations, and by deficient nerve supply. It is a singular fact, and an apparently contradictory one, that the heart and kidneys do not share the atrophy elsewhere so apparent, while the heart especially may be hypertrophied. But if it is remembered that the capillary system of blood vessels is to an extent degenerated and partially obliterated, and that the whole arterial system has to a degree lost its elasticity, it is not difficult to realize that a greater force must be exerted by the heart to propel the current of blood through its

circuit, and that in consequence it becomes hypertrophied. On the part of the kidneys the physiological reason is that the larger amounts of waste arising from non-assimilation of nutrient matters and destruction of tissues, cause a greater proportionate effort by these for elimination, and thus their bulk and vigor are preserved, and perhaps increased.

The results of all these changes are very numerous. Muscles of voluntary and involuntary life may undergo fatty degeneration, where the first, in the lower limbs, may reach the extent of paraplegia, and in the last, the heart is very generally thus affected. In consequence of obstruction to the flow of blood through non-elastic arteries and diminished capillaries, the veins are over-filled, become varicose and tortuous, as seen in varix and hemorrhoids, and even whole regions may lose their blood-supply, as seen in senile gangrene. Cerebral softening and apoplexy frequently result from obliteration of the arteries of the encephalon.

It is difficult to say at what point of these alterations the physiological ends and the pathological begins. Senile atrophy is a passive process, and is physiological. Atheroma, a degeneration, is an essentially senile change, and whether it depends upon atrophy, or is a deflection of nutrition, is a pathological process. Atheromatous obliteration of arteries by local changes or emboli, is a frequent cause

of cerebral hemorrhage and softening, as it is also of gangrene of the extremities.

The greater rigidity of the thorax is a matter of common observation, which depends not only upon atrophy of the respiratory muscles, but upon greater rigidity of the bony and ligamentous framework. There is, therefore, less vital capacity, greater frequency of respirations, and diminished exhalation of carbonic acid. This deterioration may begin as early as the thirty-fifth year, and reaches its maximum at about the seventieth year. These conditions very largely account for the predisposition to, and the severity and fatality of, pulmonary diseases in the aged.

The secretions in general are diminished. The skin and mucous membranes are dryer, their secreting structures requiring greater stimulation for the exercise of their functions. In consequence there is less perspiration, less of gastric and intestinal fluids. It is well known that serious interference with cutaneous transpiration is apt to induce nephritic complications, and it may be that this condition of the skin may strongly predispose to the diseases of the kidneys to which senile life is so liable.

In old age severe attacks may be manifested by comparatively slight symptoms. For instance, in the adult the passage of biliary gravel gives rise to severe symptoms, while in the aged the condition

is often difficult of recognition. Error in diagnosis would be very easy. In renal gravel the same is true, the passage being almost painless. Diabetes may be overlooked, as a but slightly increased quantity of urine may yield sugar intermittently; and thirst, a pathognomonic symptom, may be absent. Cancer of stomach and liver may develop without exciting suspicion of the real condition. Pneumonia may run a latent course. It is stated on the authority of Charcot that this disease may be masked entirely; as, it may appear as a cerebral apoplexy, no brain lesion; or in the guise of a true hemiplegia, no brain lesion. Such cases always terminate fatally.

Some immunities are gained in advanced life, the eruptive fevers, typhoid fever, and phthisis being quite uncommon in this period.

6. *Sex.* The liability of the respective generative systems to characteristic diseases is clear enough. The male sex shows greater development of brain and brawn; has stronger animal impulses; tends more to indulgence of passion and appetite; is brought into closer contact with the vicissitudes of life, and therefore the proclivity to disease is gained through these and similar channels. The female sex, outside of tendencies derived from the generative functions, shows a predominance of nutritive and sympathetic and reflex phenomena, and therefore to flesh and blood changes, to sensory dis-

orders, to convulsive and other affections of the cerebro-spinal nervous system; and now, if to these there be added that unstable factor, the generative system, the conditions favorable to the development of diseases peculiar to the sex are apparent, and especially the development of growths.

7. *Occupation.* In given cases there are implied: sedentary occupations, those which involve lack of exercise and perhaps impure air; overwork, physical, mental or nervous; exposure to heat, cold, inclemencies of weather; constrained and unnatural postures; the use of poisonous materials, as lead and mercury; the inhalation of irritating particles, as of iron, stone, lime; all of which with a host of similar causes, tend to disease, to determine the outbreak of diatheses, and to complicate other diseases.

VII. ETIOLOGY—ACTIVE CAUSES.

The active or exciting causes of disease are mainly mechanical, chemical, and septic.

Mechanical. These are first the results of violence, as blows, cuts, lacerations, fractures, and many others. There is pressure of clothing on various parts, as about the neck, waist, and extremities, which interfere with innervation and circulation.

Faulty positions under various circumstances have the same results. Internal conditions also act mechanically, as cystic and biliary calculi, impacted faeces, pelvic and other growths, which by pressure and interference with the functions of other organs, cause disease. Then there is a great variety of structural changes, themselves results of disease, which are harmful, as tumors, infiltrations, and consolidations.

Chemical. These are classed as *irritants* and *corrosives.*

The *irritants,* dilute acids and alkalies and various salts, act merely as such, any further effect being successfully resisted by the tissues.

The *corrosives,* strong acids and alkalies, some metallic salts, chlorine, iodine, etc., decompose the tissues by their powerful affinities or repulsions, and thus the part dies. The chemical reaction of the corrosive poisons is with the albumen of the tissues. The elements are totally or partially destroyed. The action of the different salts varies; in one case the compound formed with albumen is soluble, and in another it is insoluble; and therefore absorption does or does not take place, or is greater or less.

Many of these substances are classed as *poisons,* which, in a wide pathological sense, are: "substances capable of injuring the body, either by causing damage to the tissues or by producing functional dis-

turbance." Authorities divide them into *irritant* and *neurotic*.

The *irritants* include acids, alkalies, metals and metalloids or salts, and vegetable substances.

The *neurotics* include such as affect the cerebral, spinal, cerebro-spinal, and cerebro-cardiac systems of nerves. For the most part they have neither irritant nor corrosive action. They are clearly selective in their action, that is, they constantly and characteristically affect some part of the nervous system.

The following tissue changes have been observed as secondary effects of poisoning by some of these substances:

Arsenic: Fatty degeneration of heart, liver, kidneys and muscles. Later, atrophy of the epithelial structures of glandular organs sets in, and the fat already deposited disappears.

Antimony: In chronic cases, or when not very soon fatal, there are fatty changes in the mucous membrane of the stomach, and in liver and kidneys. Stomach and bowels present characteristic irritations even if the poison be introduced into the circulation; and the same is true of arsenic.

Phosphorus: Fatty degeneration in the liver is very marked, and kidney epithelium is similarly affected, as also are the heart and voluntary muscles.

Lead: Chronic interstitial nephritis extending

from the epithelium, which is first attacked. The spinal cord undergoes organic change.

Sulphuric acid: Fatty degeneration of heart and striated muscles, and action upon the kidneys similar to lead.

Phosphoric, and other *mineral acids*, are said to produce similar degenerations in some degree.

It is of interest to observe, more especially as it has an important practical bearing upon the therapeutics of nutrition diseases, that a leading characteristic of all is deficient oxidation, which is also a constant characteristic of these diseases. As a matter of course believers in the law of similars quickly seize upon such facts as a basis for prescription.

The *septic* group is also a greatly varied one. Such affections are constitutional and generally acute, and are popularly known as blood-poisoning, due to the absorption of various putrid substances into the blood, which are supposed to act as ferments and so to change it that it cannot fulfill its physiological functions. There are recognized: a *true* putrefaction of the blood as distinguished from septic infection; *gangrenous*, due to absorption of the putrid products of gangrene; *internal*, due to absorption of putrid matter from a typhoid or variolous abscess, vesical catarrh, osteomyelitis, or phlebitis; *lymphatic*, in which the infecting material has entered the circulation by way of the lymphatics; it is rapid in its

course and severe, and characterized by effusion into serous cavities; *pure*, characterized by symptoms of intense blood-poisoning without the development of local lesions; *surgical*, consecutive to wounds and injuries; *venous*, that form in which the infection proceeds from a putrid thrombus, as in uterine phlebitis, and is similar to metastatic pyaemia, especially in the occurrence of metastatic abscesses *(Foster)*.

The active principles of these poisons are known as *soluble ferments*, or *enzymes*, formed only by living animals and plants, and thus in this case they are supposed to be the products of bacterial life, which, having been attracted by the presence of dead matter, have propagated, and during the process, by their decomposition or secretions or chemical action, have given rise to such poisonous products, which find their way into the circulation. These bodies are also known as *ptomaines*.

There are some symptoms common to all cases of septic infection. There is prostration, even to collapse, and failure of heart action; vomiting and diarrhoea; rigors and fever. Occurring most frequently in association with some other, particularly some infectious disease, the symptoms are often complicated and obscure. But that such symptoms are really due to septic absorption is proven by the facts that such infection occurring in the healthy the signs follow; and that the presence of certain condi-

tions prevents them, and the adoption of certain measures controls them.

VIII. ETIOLOGY.—SPECIFIC CAUSES.

Specific causes are of known or unknown character; they present modes of disturbance which are uniform and constant, and they override all predisposing conditions. They are classified as:

Animal; including toxic substances produced by animals either for purposes of offense or defense, or results of disease; the microzoa, which include the whole range of parasitic life; the microphytes, bacteria, or schizomycetes, which lie on the doubtful line between the animal and vegetable, "the great majority of which are not only harmless, as far as man is concerned, but beneficial. *They feed upon dead, insoluble organic matters*" (*Billings*).

Vegetable; including the poisonous principles of plants, and the microscopic vegetable organisms.

Mineral; including the introduction into the body of the substances in toxic doses, long exposure to atmospheres containing them, and the use of potable waters which hold them in solution.

Aerial; including deleterious substances carried by the air, or held in solution or diffusion in it, vaporous, gaseous, or solid. There are impurities

from accumulation of respiratory and excretory products; from organic poisons; from deterioration; from sewer emanations; from defective artificial heating apparatuses; from damp; from metallic and inorganic substances; from specific toxic substances; from soil emanations. Besides, there are all the effects produced by changes of temperature, pressure, humidity, electric tension, and, possibly, magnetic fluctuations, sun-spot periods, and the pandemic waves of disease influences, to be reckoned with.

Zymotic; disease-producing through the process of fermentation.

There are two kinds of fermentation. The alcoholic and other kinds of fermentation and putrefaction are induced by living organisms, ferment fungi, of which yeast is an example, and these are known as *organized,* or *formed ferments.* The other is the product of chemical work within the cell (*Hammarsten*), and is but the consequence of antecedent chemical action (*Dujardin-Beaumetz*). These are known as *unorganized* or *formless ferments,* or *enzymes.* They are concerned in all the splitting processes and decompositions to which matters are subjected in preparation for metabolic processes.

The organized ferments are living things, microorganisms, and to these we look for all putrefactive decompositions of dead matter, and thus for all sep-

tic processes in disease; while to the enzymes, or unorganized ferments, "the consequences of antecedent chemical action," we look for all metabolic decompositions, and therefore in disease for the auto-intoxications and specific types. The same distinction applies to *ptomaines* and *leucomaines,* the first being the result of the action of organized ferments, or bacteria, and the other the result of the action of unorganized ferments, or enzymes, the products of physiological exchange.

The latter process is known as *zymosis*, from which this class of diseases takes its name.

It is here that the science of Bacteriology takes its rise. Many of its conclusions are far from being generally accepted, and to the writer it appears that the above definitions afford some valid and unanswerable objections to them. The subject cannot be discussed here, but is recommended to your most careful consideration.

Diseases known as *specific* are limited in practice mainly by the fact of transmissibility, or their spread by *contagion.* Thus a *contagious disease* is one that is mediately or immediately transmitted from person to person through contact one with the other, or with objects retaining the toxic principle. They are also known as *communicable* diseases.

Specific diseases are *sporadic* when occurring as isolated or widely scattered cases; they are *endemic*

when they prevail in a definite locality, or among a certain class of persons; they are *epidemic* when they affect a great many persons in rapid succession, depending on agencies not localized, and may affect wide areas, or even a whole country or continent, when they are said to be *pandemic*. Whether limited or unlimited, the essential nature of the disease remains the same.

The wide prevalence of *malaria* makes it a matter of especial interest. Some peculiar modifications of heat, moisture, and vegetable decomposition, are constant pre-requisites to the development of malarial fevers. Degrees and alternations of heat and cold; relative humidity; rise and fall of ground-water, and rapidity of evaporation; geological formations and chemical constituents of the soil are all factors, and sufficient factors, of the disease.

The essentials of malarial fever may be summed up as follows:

1. Exposure to an atmosphere saturated with moisture; itself depressing to animal life.

2. Exposure to an atmosphere that has retained the products of vegetable decomposition in excess; depressing again, with depravation of the tissues of the body.

3. An atmosphere excessively heated and chilled at regular intervals and saturated with moisture; depressing still, with the addition of rhythmical movements of chill and heat.

4. An atmosphere deprived of ozone; depressing again, because the healthful stimulus to respiration and circulation is cut off, as well as the protection afforded by its power to neutralize or destroy noxious substances.

Such is the genesis of malarial fever. If results upon tissues are such that they attract the bacillus malariae, or any other, as they probably do, the character of the disease is not, therefore, one whit changed, nor is the micro-organism at all essential to its full development.

IX. THE ELEMENTS OF DISEASE.

1. *The contractile structures.*

Their functions are *irritability*, *tonicity*, and *contraction.*

Muscular fibre, of which the contractile tissues are mostly composed, gives its first action, that of contraction, upon the application of nerve stimulus, the nerve itself being connected with a centre in which the stimulus is perceived and the response is derived. The effect of mechanical stimuli applied to either muscle or nerve is carried to the centre by the same mechanism, a sensory nerve, when from thence a response traverses a motor nerve, and the

muscle contracts. But cut off both motor and sensory nerves and the muscle still contracts; remove it from its attachments, and it still contracts.

The first phenomenon is called *muscular contractility;* the other *muscular irritability*, or *tonicity.* It is important to know that the supply of arterial blood will itself maintain tonicity for a long time after the nutrient nerve, or, as it is called, the trophic nerve, is cut off. These facts lead us to suppose that tonicity may depend upon, first, the chemical transformation that takes place between the oxygen of arterial blood and certain substances, waste and nutrient, a process going on continually, the same that results in bodily heat; and, secondly, upon the vaso-motor nervous system, for this is the regulator of blood-supply. There is the greatest necessity for discrimination of these conditions. Muscular contraction does not necessarily imply the integrity of nerve supply, nor normal nerve supply that contractile power is intact. The excess of irritability is always a pathological fact and implies weak function, as in irritable heart, stomach, intestines, and bladder, the muscular structures of which are weak in proportion as they are irritable. Such cases may be due to hyperaemia, to an irritating quality of the blood, and to irregular or disproportionate nerve supply.

2. *The nervous structures*, including the cerebro-

spinal axis, sympathetic system, ganglia and fibers.

Their functions are *sensation, voluntary* and *involuntary motion,* and *reflex action.*

Nerve systems consist essentially of cell and fibre—a cell of origin and fibre of communication or transmission. The cell is the centre; the fibre is the avenue to and from the periphery. The cell originates and receives impressions, and the fibre carries them to and from their distribution. These are the fundamental facts of neuro-physiology, and any variation from this arrangement is the fundamental fact of neuro-pathology. This is true of either division of the nervous system, motor, sensory, reflex, or sympathetic; it is true of any centre, cerebral, cerebro-spinal, spinal, or ganglionic. For instance, disease of a motor tract interferes with voluntary motion. Its actual seat may be either peripheral, or spinal, or cerebral. It is, therefore, another fundamental fact that whether the disease be at the periphery, or in the spinal cord, or in the brain, motor paralysis is the result. The same is true of the sensory tracts, and of the reflexes. Excessive, deficient, perverted, or degenerative action, are characteristic of diseases of all these systems.

Remembering now to associate these conditions with those of the muscular system just spoken of, and vascular conditions, within such limits lies the basis of the whole system of neuro-pathology, and

of neurological diagnostics; therefore, it is upon such acute discrimination that depends success in the treatment of the formidable diseases of the nervous system.

3. *The secreting structures*, glands, glandular organs, mucous and serous surfaces.

Their functions are *secretion*, each tissue of its own peculiar fluid or substance, and for its own especial purposes.

In disease the tissues become hypertrophied, atrophied or degenerated, and their products excessive, deficient, or perverted.

Secretion takes place in the cells of organs designed for that purpose, and there is a constant relation of cause and effect between the organ and its product; as, liver and bile, kidneys and urine, mucous tissues and mucus, serous tissues and serum, etc. Relations to the whole organism are also constant. For example, some of the products are residues or waste, as such only, as in the constituents of urine, exhalations from the lungs, intestinal contents, known as *excrementitious products*. Then there are provisional wastes that, being set free, fulfill important offices by entering into other processes by chemical combinations or mechanically, as, bile in intestinal digestion, and mucus in the large intestine, known as *recrementitious products*. Others serve nutritive purposes, as gastric and intestinal

fluids; and reconstructive purposes, as the spleen upon the blood, and the thyroid gland upon nerve tissue. Others are for mechanical purposes, as, serous, mucous, and synovial fluids. Still others are conservators or regulators of bodily conditions, as perspiration in regulating temperature.

Now all these functions may be excessive, deficient, or perverted. The effects of excess are of two-fold nature: First, it overdrains the blood of the elements of which the product is composed, and overtaxes the tissue which elaborates it, thus debilitating both blood and tissue. Next, it stimulates and irritates the organ the function of which it subserves; as excess of bile irritates the intestine; excess of bronchial mucus causes cough; excess of serous fluid causes dropsy, as in hydropericardium and ascites. Deficient secretion depends upon a debilitated organism, or circulation, or secreting organ, and this affects in two ways. The matters which should be excreted are retained, with toxic results; habitual discharges, constant or periodical, if retained, cause general or local congestion and inflammation. The results of failure of secretion of bile, and urine, and bronchial mucus, and menstrual fluid, are familiar examples. Again, processes that depend upon secretions for their completion fail, if the secretion is deficient or absent; as intestinal digestion fails if bile is not furnished; blood fails to be aerated in the lungs

if bronchial mucus is deficient. Perversion results from either excess or deficiency, in one case being diluted and therefore too weak, and in the other concentrated and therefore too strong. The secretion is altered in some diseases, becoming by virtue of such qualities the source of new disorders.

4. *The blood and vascular system.* The first includes the substances that enter into its composition, red and white corpuscles, fibrin, serum, and salts. The second includes the whole mechanism of the circulation.

The functions of the whole are to distribute nutrient materials, oxygen, and heat to the body, and to convey effete matters to their proper organs for elimination.

In disease the blood may be impoverished in whole or in part; its quantity increased or diminished generally or locally; its quality perverted by retained products or others introduced into it. The organs that are related to it, such as depend upon it for their activity, or it depends upon for quantities and qualities, as the lungs, liver, spleen, bone-marrow and lymphatics, may refuse to take up or give up their proper elements. The blood-vessels, besides being the subjects of diseases from causes that affect tissues generally or in particular, are predisposed to those peculiar to themselves, the causes of which are operative in no other system.

In view of the fact that tissue nutrition is carried on by blood which normally contains a fixed proportion of red corpuscles, that these carry a fixed proportion of haemoglobin, and that this attracts a certain amount of oxygen for nutrient purposes, it follows that if a larger amount of oxygen is taken up by an excess of haemoglobin and red corpuscles, the chemical transformations are over-active or excessive. As a matter of fact the vital operations of the body then proceed under excitement. The blood of persons of sanguine diathesis is said to present a larger proportion of red corpuscles than others, and they are therefore very active and excitable, and peculiarly liable to diseases of active inflammatory character. The heat of the body is raised, heat production running to extremes, and therefore fevers give high temperatures. Muscular irritability is exalted, and therefore there is the bounding heart and general muscular restlessness that occur in these diseases.

On the other hand a deficiency of red corpuscles is said to be characteristic of the lymphatic diathesis, which, on similar grounds, accounts for the general sluggishness of such persons, for their low powers of resistance to conditions inimical to health, for the low type of their sicknesses, and for the tendency to degenerations. In them there is general weakness of functions, prominently digestion, circulation, and metabolism.

Altered conditions of blood are known by names that indicate the character of the change. In *anaemia* both quantity and quality are changed. There are always present alterations of chemical composition, which extends to the corpuscles. Two forms are distinguished: *oligaemia*, diminution of the volume of blood in circulation; and *oligocythemia*, diminution in the number of corpuscles, chiefly of the red, which is always associated with diminution in the amount of haemoglobin. Should there be at the same time an increase of white corpuscles the condition is known as *leucocytosis*, which may be temporary, or *leucocythemia*, or *leukaemia*, if the excess is persistent. These conditions are important in view of the disturbances of circulation for which they are responsible.

It was said that the bloodvessels, including the whole vascular mechanism, besides being the subjects of disease from causes that affect tissues generally or in particular, are predisposed to those peculiar to themselves, the causes of which are operative in no other system. Those of the first class need not be considered here. Those of the other all depend to a great extent, if not wholly, upon *pressure*, of which there are three kinds: *haemodynamic*, that which depends upon the heart-impulse and its communication to bloodvessels; *haemostatic*, that which depends upon gravitation, and which is vari-

able according as the postures of the body are variable; and *lateral*, which is the expansive power of liquids in confined spaces.

The circulatory system is composed of *arteries*, for the most part contractile; *capillaries*, with extremely tenuous and permeable walls; *veins*, supplied in part with valves, with passive walls; and the *heart*, a contractile organ of great power, which forces the blood through the vascular circuits. Taking into account the force exerted by the heart, the resistance and contraction of arteries, and the passive obstruction offered by venous blood columns enclosed within non-contractile tubes, it is seen that the circulation, from the point of view of mechanics, becomes one of complexity rather than of simplicity; while if to these complications there be added the weight of columns of blood, which may be ever changing, or may have to be sustained, at given points, at their maximum for comparatively long periods of time, the complexities are greatly multiplied. The propulsive power of the heart must be different, the resisting and contracting power of arteries must be different, in the case of an erect body, from one in the horizontal position, and so must effects upon capillaries and veins be different in the same cases. The height of the heart being taken as the level at which the force originates and also completes itself in perfectly normal conditions, vari-

ation from this must constitute an important abnormal condition. The heart being situated, in effect, between two systems of circulation, one above and one below its level, the effect of gravity upon the one above must be different from the one below; in fact, while that below is an ever-increasing plus quantity from above downward, that above is an ever-increasing minus quantity from below upward. This is emphasized by the fact that blood vessels of head and neck are thinner and sparingly supplied with muscular fibers, while those of the lower extremities are thicker and very freely supplied with muscular and elastic fibers.

But it is not gravity-pressure, that in perpendicular lines, and cardiac-pressure, that of heart-impulse, alone, that are involved. Lateral pressure, that in horizontal lines, a compound of weight and propulsive force, is a direct consequence. This must be very great in the lower extremities, and correspondingly little in the cerebrum; which, considering the comparatively greater or less support given the vessels by surrounding tissues in either organ, becomes of extreme importance in consideration of diseases of blood vessels in these regions. Thus, in particular, in dealing with diseases of the lower extremities, bladder, rectum, and kidneys, such as varix, cystic and rectal hemorrhoids, and obstructive renal disorders; and with those of the upper regions,

as in cerebral disturbances, we are bound to estimate the value of these elements.

According to Landois, in persons suffering from granular or contracted kidney and sclerosis of arteries, and after lead and ergot poisoning, arterial pressure is raised, and so it is in cardiac hypertrophy with dilatation. It falls in fever, and is low in chlorosis and phthisis. Blood-pressure in veins is increased by all conditions which diminish the difference of pressure between the arterial and venous systems, and is decreased by such as increase the difference. General plethora of blood increases it, and anaemia diminishes it.

5. *Nutrition.*

This signifies "the function possessed by living organisms of repairing tissue waste by the absorption and assimilation of new alimentary materials; also the state of well-being kept up by that function." In this day we use the term in the more comprehensive sense of *metabolism*, "the series of chemical changes occurring in nutritive material taken into an organism by which it is converted into an integral part of the living substance, also the changes taking place in living substance by which energy is set free. In the setting free of energy the complex material in the living substance is reduced to a simpler form, oxidation occurs, and carbon dioxide and other waste products appear" (*Foster*).

One side of the process is synthetic or constructive, and is distinguished as *anabolism*; the other side is analytic or destructive, and is termed *katabolism.* The first part of the process is also spoken of as *assimilation; elimination* or *excretion* represents the process by which waste matters are thrown off.

By virtue of metabolism the organism evolves its energy, which is *potential* if stored up or conserved, and *kinetic* if expended in muscular work and heat or is transformed into other kinds of force. The whole process involves many operations, mechanical, chemical, and dynamic; is continuous and extends from the ingestion of proper quantities and qualities of materials, through digestion, assimilation, and transformation of tissues, to the final formation and elimination of effete products.

But every part of the process, and even the whole process, is distinctly relative. This is spoken of as the *equilibrium of metabolism.* If physiological conditions are normal, that equilibrium shall be maintained it is required that the amount of the end or waste products shall equal the amount taken up and assimilated at the beginning of the process. That is, income and expenditure must equal each other.

However, this fact is open to apparent qualifications. The growth of the body during infancy and

childhood represents increasing formation, and senile life represents decreasing formation; but in either case equilibrium is practically preserved, for the increase of tissue and less waste of the one stands over against decrease of tissue and more waste of the other.

There is another fact of importance. The work done by any given sum of force involves waste to correspond with the outlay. Therefore supply and demand tend to equal each other. If the supply of food is greater than is required to repair the waste of work, it is thrown off unassimilated; or, being assimilated, is stored up in potential as fat; or, if less than is required, the body loses weight and potential accordingly. These conditions represent the maximum and minimum limits of metabolism.

It is evident that since by means of the blood the tissues are nourished, and such waste matters as are the results of metabolism are removed, that there are two currents, one, the *afferent*, to the part, and another, the *efferent* from it. An equilibrium must be maintained here as well as between the intake of nutrient materials and their equivalent in end-products. For, if the afferent stream overloads the excretory systems, and thus poisonous products cannot be eliminated, they must remain in the tissues; or, if lymphatics and veins, the efferent stream, be interfered with, similar results must en-

sue. This is recognized as the physical basis of auto-intoxication.

Recalling now some other facts of physiology, we find that there is positive evidence of expenditure on the part of the body, as follows:

From the lungs, every twenty-four hours, 20,000 grains of carbonic acid and water.

From the skin, 11,750 grains of water, solid and gaseous matter.

From the kidneys, 24,000 grains of water, organic matter, minerals and salts.

From the intestines, 2,800 grains of water, and various organic and mineral substances.

The whole equals 58,650 grains of solid and gaseous matter, and water, fluid or combined, expended in twenty-four hours—about 8 1-3 pounds.

Now, according to the foregoing, there must be a corresponding supply to maintain the body in health and bulk and strength, and it is found that there are supplied, daily, as follows:

Solid food	8,000	grains.
Water	37,650	"
Oxygen	13,000	"
The total	58,650	"

equals expenditure.

Thus the fact remains that income stands for the possibilities of both kinetic and potential energy; that chemical processes conserve or release it; that

dynamic power directs its transformations; and that the residue, the mass rejected, "is matter, the chemical attractions of which have been in great part or wholly satisfied."

Such is the known potential which in course of activity expends itself mainly as follows:

1. *Statics;* the mere passive existence of a thing involves force; the maintenance of stability involves force; the fact of potential involves force to preserve it as such.

2. *Heat;* which must be sufficient to maintain a uniform degree of temperature all over the body under all conditions.

3. *Motion;* voluntary, as in all ordinary muscular movements; and involuntary, as in respiratory and circulatory movements.

4. *Nerve force;* including cerebral, spinal, and ganglionic functions, as in motion, sensation, the reflexes, and automatism.

5. In processes purely physiological or vital, such as development and reproduction.

To state the whole problem in mathematical terms, the amount of energy liberated from the potential stored in 8 1-3 pounds of food, water, and oxygen, administered daily to an adult, is equal to 3.400 foot tons.

X. NUTRITION—DISEASE TYPES.

Hypertrophy typifies excessive nutrition. *True hypertrophy* is not essentially different from the normal physiological process, and consists in an increase in size of the individual elements. *False*, or *numerical hypertrophy*, or *hyperplasia*, consists in an increase in the number of tissue elements. *Pseudo-hypertrophy* consists in a combination of atrophy with excessive development of adipose tissue. In either case the bulk of the organ is increased.

True hypertrophy usually depends upon some particular cause, the effect of which is limited in extent, and therefore it is limited to particular organs. The attraction of blood and nourishment to the part may be normal, as in over-development of muscle from constant use; it may be abnormal, as in the case of morbid irritation at the seat of hypertrophy. Examples are, the heart, which becomes hypertrophied in consequence of continued stress or excitement; the bladder, in overcoming the obstruction caused by enlarged prostate; the muscular structures of stomach and intestines in consequence of obstruction; and of the bronchia as a result of asthma. In all of these cases the condition has been brought about in the course of increased expenditure of force, in that an extraordi-

nary demand has been made upon the muscular structures, and to supply the demand made upon them they add to their bulk more of like tissue, until an equilibrium is established. The new tissue is of the same character as the old in every respect, and has the same origin; and is therefore a normal tissue. These are *compensatory hypertrophies*, that is, it is necessary for a certain purpose that there shall be exerted a certain amount of mechanical force; if the organ drawn upon falls short of the amount required, it proceeds to add to its elements until it is equal to the requirement, when an equilibrium is established. These are also known as *hypertrophies by stimulation.*

In the case of muscles it is important to note that hypertrophied voluntary muscles rarely produce disorder, unless it be of a strictly local character, and not even that in most instances; while in involuntary muscles there are produced both general and local disorders.

Hypertrophy by increased blood supply may be purely normal, as in enlargement of the uterus in pregnancy; in some cases of obesity; in one kidney when the other is disabled, and the like.

Hypertrophy by irritation presents different characteristics. There is still stimulation, still increased blood supply, but they are not present by reason of any physiological process, or to answer any demands

for increased force; they are present because attracted by an irritant, and the results in all such cases are degraded tissues which tend to degeneration. It is pathological always; while the others are physiological. Hypertrophy of lungs, liver, spleen, cellular tissues, and mucous membranes are of this character.

The hyperplasias, because they add to the number of tissue elements, are also pathological. There may be transformation of tissue or not. It is essentially new formation, and the *neoplasia* may be so classed. It may also occur in connection with hypertrophy.

The foregoing are recognized as *progressive* changes. *Retrogressive* changes are typified in the *Degenerations.*

"*A degeneration is any process whereby a cell element or tissue undergoes such molecular changes that it can no longer maintain its functional activity, and either separates into its organic constituents or gives rise to the formation of a new product at the expense of its own substance.*" [This and the following definitions of the degenerations are from Hamilton's Pathology].

Atrophy. "*Atrophy is the diminution in size or absolute destruction of a part which results from direct and continuous over-pressure where the blood supply is not deficient.*"

The change is always degenerative and the definition does not admit any form of mere shrinking or wasting. The latter frequently occurs when of itself it is in no sense pathological. Other writers admit varieties, as: *simple*, mere wasting or loss of substance occurring in the progress of diseases; *senile*, due to exhaustion of elements; *marasmic*, a sort of premature senility, exhaustion; from *disuse*; *neurotic*, which, on account of trophic or motor-paralysis, may manifest both the degenerative and non-pathological types.

Two sources of atrophy present themselves, one that deranges or prevents the nutritive reparatory processes, and one that promotes decay beyond the powers of repair.

Among the causes that promote decay are the influences that continuously exhaust the body as a whole, such as prolonged or over-exertion, excitement, loss of sleep, anxiety, suffering, over-drain of the tissues by intestinal, renal, and cutaneous channels, and loss of animal fluids. Examination of the excretions in such cases shows an excess of the products of metabolism, and all such wastes are abnormally prone to decomposition and putrescence. It is important to know that these conditions may induce a low or hectic type of fever, which might be mistaken for a cause, whereas it is a result.

Many causes impair or prevent reparative nutri-

tion. Among them are: insufficient food, quantity or quality; imperfect digestion; obstruction of channels between blood vessels and lymph-channels, as of thoracic duct; defect of the process by which blood is elaborated, as in diseases of spleen and lymph-glands; disproportionate appropriation of elaborated nutriment, by such as morbid growths, which are fed to excess while other tissues starve.

The cell or fibre becoming atrophied first loses its outline and shrinks, and is finally reduced to a small granular body. The granules lose their cohesion, separate, and are removed by absorption.

Fatty degeneration. "*A chemical change in a cell or fibre by which it becomes destroyed from the conversion of its albuminous or proteid constituents into oil.*"

Fatty degeneration is an effect of malnutrition, and must be distinguished from fatty infiltration. "An infiltration is a process by which a substance normally existing in the body, or foreign to it, is poured into a tissue or organ from without, which does not necessarily destroy its vitality, but merely affects it mechanically by pressure or otherwise." The process is therefore quite different from the metamorphosis above defined. The common adipose tissue is an example of the latter, and it is only where such deposits become excessive that they are pathological.

The difference may be summed up in this: in

fatty infiltration free fat, deposited in the form of drops, may be formed from an excess of circulating albumen; while in fatty degeneration the organized albumen is attacked and broken up into granular, albuminous, or albuminoid and fatty molecules.

The fatty is the most common form of degeneration, and always depends upon malnutrition. Whatever may be the special cause at work in any individual case, all fatty degeneration is caused by *deficiency in the supply of arterial blood*, and this may be induced in various ways. Thus an organ becoming hypertrophied may outgrow its blood supply—a condition well exemplified in cases of heart disease, and of obstruction to outflow of urine. The heart in one case and the bladder in the other become hypertrophied to meet the increased work thrown upon them, and so long as the vascular supply increases in the same proportion, all goes well. But the day comes when the tissue outgrows its blood supply, and then fatty degeneration ensues, the hypertrophied organ becoming dilated and soon failing to expel its contents. The same is true of morbid growths and inflammatory products, especially of scrofulous and tuberculous character, all of which, if they outgrow their blood supply, take on the fatty change. Thus, whether the increase in size of an organ be due to hypertrophy, to new formation, or to inflammatory exudation, unless the blood supply in-

creases in proportion to growth, fatty degeneration sets in. Again, it may result from the loss of normal blood supply. Take the heart again as an example. If from any cause the coronary arteries fail to supply the heart muscles with a due supply of blood, fatty degeneration of the ventricular walls commonly results.

The tissues most affected are liver, kidneys, heart, arteries, voluntary muscles and nerve tissue.

Hyaline degeneration. When necrosed tissues are protected from the action of external air and putrefactive agencies, a change of structure may take place which presents the appearance of an homogeneous, transparent or translucent substance. This is known as the *hyaline degeneration.* It is not, however, necessarily associated with necrosis.

Four forms have been differentiated, the simple, mucoid, amyloid, and colloid.

The *simple* form consists of homogeneous masses of firm consistence, and chiefly affects lymphatic glands, neuroglia and vessels of the brain, and the stroma of epithelial tumors. In these structures it collects in and around the blood vessels, and in these chiefly in the fibrous tissues. In the degenerative stage of arterial sclerosis it is conspicuous.

The mucoid or myxomatous form is "a degeneration chiefly of connective tissues characterized by the transformation of the matrix into a jelly-like substance containing mucin."

Pathologically, it is commonly found in degeneration of connective tissue tumors, fibrous, sarcomatous, cartilaginous, or fatty. It is most common in the sarcomata. It is sometimes found in the structure of diseased organs.

The amyloid, waxy, lardaceous, or albuminoid form "is the infiltration into an organ or tissue of a peculiar foreign and solid substance having a composition identical with albumen"

Infiltration with this substance gives a dry, glossy lustre, like a wax cast. Its hardness gives to organs a peculiar rigidity, not hard and unyielding, but elastic. Organs so affected are usually greatly enlarged.

In such severe general disturbances of nutrition as occur in tuberculosis, syphilis, long-continued profuse suppuration in bones and soft parts, the change may be widely distributed over the body. The organs chiefly affected are liver, spleen, kidneys, intestines, suprarenal capsules, and thyroid gland. In all these situations the middle coat of the smaller arteries is almost always first affected, the larger usually escaping. It is an almost constant characteristic of senility.

The substance is derived by direct metamorphosis from the fibrin of the blood, and depends upon nutrition disturbances.

The colloid form "is a degeneration by which cellu-

lar structures, especially those of an epithelial type, become converted into a peculiar structureless semi-solid substance, homogeneous and of jelly-like consistence."

Its chemical nature is still uncertain, but appears to be a complex and varying mixture of a number of albumins and albuminoid substances. Virchow concluded that in the thyroid it was an alkali-albumen precipitated by excess of chloride of sodium.

Its especial seats are epithelial tissues, thyroid body, cancerous tumors, ovarian cysts, and in various diseases of the kidneys, where it gives rise to the hyaline casts.

Calcareous degeneration. "*The deposition within a tissue of insoluble compounds of lime and magnesia.*"

These deposits occur *within* tissues as *calcification; upon* them as *incrustations;* and in cavities and spaces as *calculi.*

In the cartilages of the ribs, small arteries, and in myomatous tumors may be found examples of the first; the deposits of urates upon joint surfaces, and the walls of the pelvis, of the kidney, examples of the second; and numerous forms of calculi, of the last.

Except in the retrogressive calcareous change peculiar to senility, the degeneration is most frequently found in portions of tissue that are dead and undergoing disintegration. Therefore, the frequency of calcification in diseased arteries.

The deposit of *urates* is one of the most important. The articular cartilages and ligaments, tendons

and their sheaths, and the subcutaneous cellular tissue of the kidneys are the chief situations of the deposits. They consist mainly of urate of soda with small quantities of lime salts. Such conditions occur in *gout*.

Arterioliths and *phleboliths* are found in blood vessels, and are probably calcified thrombi.

The formation of *gallstones* is interesting and important. Examination of cases over sixty years of age shows that they are present in twenty-five per cent. of the cases. Bile-stasis is the first step, and the next desquamation and exudation. Bile thus becomes highly albuminous, which favors the deposit of bilirubin and calcium salts. All these form a sediment in the gall-bladder, which is finally inclosed in a firm shell of bilirubin and lime salts.

In *vesical calculi* the metabolic disturbances are most apparent. They vary greatly in location, physical characteristics, and composition. Their formation is probably ushered in by catarrhal conditions, as in biliary calculi, and thus their framework consists of albuminoid substances. In all these cases it is evident that there exists some pathological disturbance preceding the metabolic disorder. As, for example, if faulty nutrition induces an abnormal urine, which in turn induces catarrhal conditions of the urinary passages, which in turn induces desquamation of epithelium and exudation, all the elements

are at hand for the formation of such concretions, exactly as in biliary calculi.

Gangrenous degeneration—mortification. "*Gangrene is the putrefying fermentation of a dead limb or tissue still attached to the body.*"

In this connection there must be recognized the distinction between decomposition and putrefaction. *Decomposition* is a purely chemical process, one of disintegration. *Putrefaction* is a fermentation process, affects the albumins, and is induced by putrefactive micro-organisms. For instance, fatty and caseous tissues, which are dead, may exist in the body indefinitely if protected from contamination. If contaminated they putrefy; if uncontaminated they decompose. The same is true in dead external masses. Sloughing in a wound, if aseptic, is decomposition by simple fatty degeneration; if septic, by putrefaction.

The necessary conditions of gangrene are deprivation of blood supply, and contamination by putrefactive organisms.

Caseous degeneration. "*Caseation is a dry, fatty degeneration in which the albuminous and oily constituents of a tissue become converted into a substance like cheese in appearance, and somewhat allied to it in chemical composition.*"

In view of the fact that caseation is a constant and prominent feature of tubercular degeneration,

it is all important that a correct idea of it be gained, especially in association with the origin of the masses in which it occurs, and the conditions under which it bcomes so destructive to life.

Hamilton says: "When a part has fallen into this state it becomes hard, sharply circumscribed, dry and compressed. It is devoid of blood vessels. Microscopically it has a granular appearance, and under high power the actual cellular and other constituents are seen to have become shrunken, shriveled, dusky, and indefinite; finally they break down into granular matter and very minute oil globules.

"It is to be remembered that all caseous tissues are dead, and that *any further degeneration* which they may undergo is simply of the *nature of a chemical decomposition, probably induced by the presence of micro-organisms.* The caseous mass often tends to soften in the center, and the cause of this is apparently a chemical change by which the albumins of the part become converted into oil. The process is probably analogous to the ripening of cheese. In course of time the debris is absorbed or otherwise got rid of, and a so-called *phthisical cavity* results. The cavity may heal by contraction, *but if it be* CONTAMINATED WITH THE TUBERCLE BACILLUS *it is liable to induce a localized or widespread tubercular eruption.* IN THIS WAY an intractable

tubercular disease arises, and in such cases the cavity remains open and continues to discharge broken down caseous material from its walls. The cheesy mass may *lie latent so long as it is solid.*"

Weigert was in great measure justified in his claim that caseation is a *coagulation necrosis*, upon the ground that very many histological changes in tissues may be explained as purely chemical processes.

Thoma says: "It appears that, in many cases, the great new formation of cells increases the pressure in some parts of the tissue to such a degree that the circulation of the blood and tissue fluid is interrupted and local death is produced. In tubercular foci of disease there are, *in addition*, the injurious effects of the metabolic products of the tubercle bacilli. Speaking generally, *caseation of the tissues agrees in many points with the processes of disintegration which set in when fresh tissues are enclosed aseptically within carefully sterilized tubes and preserved at body temperature. In this experiment disintegration of the albumen also occurs, although* THE ACTION OF MICROBES IS EXCLUDED."

It appears, therefore, that tubercular caseation, as a degenerative process, does *not* depend, as the effect of an indispensable cause, upon the action of bacilli. Micro-organisms find a suitable habitat in caseous foci and induce "further degeneration;"

if a caseous cavity becomes "contaminated" with bacilli, it is "liable" to induce widespread tuberculization. As a matter of fact caseous masses may become inspissated and lie latent; they may soften in the center and become liquified, and be absorbed; they may become impregnated with lime salts and thus be converted into a calcareous mass; and it not infrequently happens that they become smaller by the gradual absorption of their marginal zones by contiguous tissues.

XI. TUBERCLE.

Tubercle is the visible result of a fault of metabolism, suboxidation, which produces degeneration of albumen and albuminoids in situ or in transit, and their precipitation and deposit in the tissues; by preference in lungs and intestinal lymphatics.

The process of change in the albumins is similar to those which occur in the fatty and various hyaline degenerations, varied in some characteristic way just as they are varied, and located by reason of some physiological requirement, just as they are.

Tubercular degeneration is therefore one member of a series of pathological changes having in common abnormal transformation of the albumins of the body.

There are two forms, *constitutional* and *acquired.* The first is *diathetic,* and is chronic; the other is *infective,* or *septic,* and is acute.

According to Hamilton the following are the usual histological forms assumed by the growth:

1. Some very young tubercles appear as masses of highly nucleated cells, and are looked for in very acute eruptions. They locate more especially around blood vessels of pia mater and peritoneum. The bacillus may be detected, but with difficulty.

2. *Giant cells* soon appear, which sometimes contain the bacillus, but *rarely in man.* Whether the bacillus is the cause of the overgrown cells or not, is not quite clear. They are of much more common occurrence in bovine tubercle. In acute eruptions most of the tubercles never proceed further in development than this stage, when caseation puts a stop to further evolution. The bacillus is sometimes found in the caseous part, more frequently as caseation progresses. There are many nodules in which not a vestige of the bacillus is to be seen. The little mass appears to be quite devoid of blood vessels, and it is a question whether this or the presence of the bacillus is the cause of the caseous necrosis.

3. Sometimes, in chronic pulmonary tuberculosis, the tubercle does not caseate, but goes on to an ultimate stage of organization—the fibrous. Within the reticulum lie small round cells, called *lymphoid corpuscles*, and larger, called *small giant cells.* Three zones have been distinguished in this stage of tubercle: (1) An external, composed of small round cells;

(2) a lesser, epithelial, or middle zone, containing the reticulum, and (3) a central space containing a giant cell.

4. In still older tubercles this reticular giant-cell system disappears and is replaced by a simple mass of fibrous tissue. The process represents cicatrization, or healing of the tubercle, and is the natural course of development, if not interrupted by caseation. In this stage the tubercle bacillus vanishes.

Quoting the same author: "As a general statement it may be said that in cases of tuberculosis, acute or chronic, the bacillus will be found lying in *some* of the nodules. There is this peculiarity, however, about its distribution, namely, that *it is very irregular.* The author has met with a case in which both lungs were rendered perfectly solid from an extremely acute eruption of tubercle, but *in which not a vestige of any tubercular bacillus could be discovered* after the most careful and prolonged examination. A remarkable fact was that none of the nodules had caseated. They were all yet in the cellular stage, but presented the histological features of acute tubercle. It is usually where caseous catarrhal pneumonic or interstitial tubercle nodules have caseated and are in process of disintegration that the largest deposits are to be seen; but even in lungs in this condition it is sometimes impossible to demonstrate it *with anything like the constancy that might be ex-*

pcted. The explanation usually given for such absence in undoubtedly tubercular nodules is that the bacillus has worked itself out of them [!!], the tumor being merely its effect."

Two facts stand out prominently here, and in view of indispensable bacillary causation, are difficult of explanation: the demonstration of the bacilli in undoubted tubercular nodules is extremely uncertain, they being few or absent, early or late, in cases that should yield them in abundance; and it is only in acute cases, in which an already infected bacillus has found suitable conditions for propagation, that show that the micro-organism is in any way responsible for initial conditions.

Another thing has been brought out through some very late investigations by Prudden, Strauss, Vissman, and others, upon the specific nature of epithelioid and giant cells. They reach the conclusion that the granulation nodules, composed of such cells, are not specific pathological formations caused by living or dead bacilli; the same results being obtained by indifferent foreign bodies.

Not the least important phase of the matter relates to the so-called species of the bacillus tuberculosis. Both clinically and experimentally difficulties have arisen which have led to the suspicion that it was not always the same invariable organism, with the possibility even that different organisms might

produce like effects. The point was clearly brought out in discussion at the meeting of the Association of American Physicians in 1896, in which leading bacteriologists of this country took part, upon the differences between human and bovine tubercle bacilli. It appeared to be substantially proven that the difference was not merely one of quantity, of more or less, but was an actual difference in kind, the organisms themselves being microscopically different. More than this, it had been demonstrated by experience at the Bureau of Animal Industry that inoculations of the human tubercle bacillus into cattle had not produced a single case of tuberculosis.

XII. TEMPERATURE IN HEALTH AND DISEASE.

The circulation of the blood proceeds according to certain laws, with certain definite results. Closely related to it, and in consequence of it, are heat-production, heat-dissipation, heat-conservation, and heat-transformation. Heat is, therefore, a characteristic of living animal bodies, and degrees of heat, with qualities of circulatory and respiratory movements, are closely associated together.

The production of heat is the result of the contact of oxygen with combustible substances; that is, an

affinity exists between oxygen and certain other substances, and their contact sets up a chemical process of disintegration or decomposition, the residues of which are, in animal bodies, heat, carbonic acid, urea, water, etc. The production of heat is found, therefore, in the chemical processes that occur in every tissue and fluid of the body; if the body lives it necessarily produces heat. These phenomena represent not only the chemical affinities of substances of which the body is composed, but of those which are introduced into it from without. The ever-continuing change going on in the molecular disintegration of substances introduced into and of the body, stands for the ever-continuing production of animal heat. The blood is the great receptacle of nutrient matters introduced into the body; its capacity and avidity for oxygen is also very great; it must, therefore, be the chief seat of the chemical processes alluded to, and consequently the main source of heat production. The circulation of the blood is the means for the equalization of temperature.

"Part of this heat is employed for self-preservation,"—heat conservation; "a part is converted into productivity,"—heat-transformation; "and the rest is given off in a double operation of keep and escape, first, by the circulatory system, which, not unlike a hot-water heater, carries all over the body an almost

uniform temperature; and second, by the skin, a large condensing apparatus, through which the excess of heat is converted into sweat, or escapes by radiation. From the compensating action of this great harmonizer results the normal temperature of every living body, its *norm*" (*Seguin*).

Here let medical science render its just dues to physical science. But for the discovery of the law of conservation of energy, these and many other of the present familiar facts of medical science had remained mysteries. In nature, as in mechanics, as in medicine, the expenditure of force in a given direction is exactly equaled by another, its result. Heat, light, electricity, motion, are convertible forces, one into the other. "Chemical difference is a force, and the changing of a chemical difference into heat results from combustion," and in this case of production of heat in the body, it results from the combustion of a chemical difference—the expenditure of one force is conserved in another, its exact equivalent. It is true, therefore, "that the sum of the physical power of any animal is equivalent to that of the simultaneously produced chemical processes," of whatever kind.

The human norm is as follows:

37°, Centigrade scale.
29.6°, Reaumur scale.
98.6°, Fahrenheit scale.
0°, Physiological scale.

The *centigrade* scale is constructed with the freezing point at 0 degrees, and the boiling point at 100 degrees, and the space between divided into 100 equal parts.

The *Reaumur* scale places freezing at 0 degrees, and the boiling point at 80 degrees, the space between being divided into 80 equal parts.

In *Fahrenheit's* scale freezing is fixed at 32 degrees, and the boiling point at 212 degrees, and the intervening space divided into 180 equal parts.

In the *physiological* scale 0 degrees is fixed at the human norm, 98.6 degrees F., and the length of the degree is the same as that of the centigrade, one-hundredth part of the distance between the freezing and boiling points.

It should be known how to convert the reading of one scale into another, and here are the formulae:

$$C \times 9 \div 5 + 32 = F.$$
$$C \times 4 \div 5 = R.$$
$$F - 32 \times 5 \div 9 = C.$$
$$F - 32 \div 9 \times 4 = R.$$
$$R \times 9 \div 4 + 32 = F.$$
$$R \times 5 \div 4 = C.$$

To convert F or R into P, first reduce to C; from this to P there is always a difference of 37 degrees. Reverse the process to convert P into either of the others.

It should be remembered that there are variations from the standard norm that are characteristic of individuals, just as there are in the normal stand-

ards of pulse-rate or respirations. The individual standard may be slightly above or below the general standard.

There is also a diurnal variation of about 1 degree centigrade, which shows its maximum at 3 to 4 p. m., and its minimum at 4 to 7 a. m. The variations of temperature in children, especially infants, is greater even than this, being from 3 to 4 degrees. There are some facts in this connection that should not be forgotten: "crying will cause a rise of temperature in children. Sleep or no sleep acts on the same function; a light one cools, a protracted one frigerates; the loss of it increases heat, its long privation brings on algidity." Then, for instance, do not be led to believe that a rise of 2 to 4 degrees of heat is an indication of fever until such possible causes, as loss of sleep or prolonged crying, have been eliminated; nor that sub-temperature indicates collapse until prolonged sleep or wakefulness can be ruled out as causes.

Now, with reference to the fact that heat-production depends almost wholly upon the chemical transformation of nutrient substances introduced into the body, and that to maintain a healthy standard production must equal dissipation, it becomes apparent that the all-important factor in preserving the health of infants is that there shall be given food of proper quality, in proper quantity, and under proper condi-

tions. It is of vast importance to be able to successfully manage children; for, as Hufeland remarks, "two-thirds of the sick are children."

Abnormal temperature, the temperature of disease, marks the degrees of heat above or below the physiological standard. One of three things happens: heat is produced too fast, faster than it can be dissipated, as in fever; it is produced too slowly, or is dissipated faster than it can be produced, as in algid and other conditions of depression; its proper relations to other functions are disturbed.

As direct results of these abnormal degrees of heat it is to be observed that in the first case, the heat of fever, the consumption of tissue is greater than the nutrient supply; hence emaciation. In the second case, too slow or rapid dissipation, toxic matters may remain unoxidized, and thus toxic or simple depression set in. In the last case, irregularity of relations, we find a possible cause for the deflections of nutrition that so frequently result in abnormal growths or deposits.

Briefly, in ordinary practice, thermometry is valuable along these lines. It indicates the existence of fever, and the height of temperature may be prognostic of intensity and danger; the law of a disease once made out, thermometry completes and confirms diagnosis; deviation from a typical course is shown by it; relapses and ameliorations are an-

ticipated by it; it marks the appearance of convalescence and of complications; and in surgical practice it warns against or permits the use of anaesthetics and the knife.

As already said the norm is 98.6° F=37° C, and the following are the ordinary departures from it:

Still said to be *normal* 97.8° to 99.1° F=36.6° to 37.4°C.
Febrile, 100.4° to 101.1° F=38° to 38.4° C.
High fever, 103.1° to 104.9° F=39.5° to 40.5° C.
Hyperpyrexia, 107.6 F=42° C.
Subnormal, 96.8° to 97.7° F=36° to 36.5° C.
Collapse, below 96.8° and 36° C.
Dangerous algide collapse, 95° to 96.8° F=35° to 36° C.

Temperature has relations to respiration and pulse rate which are important. "Slight fever coincides with a pulse of 80-90; moderate fever, 90-108; considerable fever, 108-120; extreme heat, 120 and upward." Every degree of heat above 98 degrees should correspond with an increase of pulse-rate by 10 beats per minute. Pulse follows temperature when improvement sets in; it precedes it in exacerbations. A low pulse with high temperature directs attention to brain, cord, or depressing drugs. Low temperature and frequent pulse points to local complications of thorax or pelvis.

Other things being equal, respirations are quickened as temperature and pulse rise, but there is no constant rule, and the relations may be entirely changed; as, in collapse the respirations may become rapid.

The range of temperature in febrile diseases may be distinguished by the following stages or periods:

The *prodromic* of which little is known.

The *initial* or *pyrogenic* stage, longer or shorter, is considered closed by the development of a localized process, or when the lowest daily average characteristic of the disease is reached.

"The *acme* or *fastigium*, during which the fever maintains its characteristic daily temperature.

"The *amphibolic* stage, stage of perturbation, whose temperature is irregular."

In case of recovery there follows the *crisis*, the first stage of *decrement*; then the period of *defervescence* or cooling; then the *epicritical* and convalescent period, when the temperature is normal or a little above or below.

In case of fatal termination, the temperatures are varied, but should be more or less characteristic; the fact is, however, that these last stages have not been systematically observed, so that no rules have been formulated.

To review these stages in a few words:

"The *initial* period has often a characteristic type, but commonly escapes observation; it is varied by the local morbid processes which may accompany the fever. The patient previously ill and feverish, the type of the stage of attack is very vague. The intensity of the symptoms, temperature, etc., in this

period, can found a diagnosis only when exceptionally severe.

The next period, or *fastigium*, affords characteristic data for a correct diagnosis in three ways: from the height of the temperature, from its successive alternations, and from the duration of this stage. By the elevation of temperature, its continuance at abnormal heights, and its deviations from the normal type, we learn the intensity and degree of danger of the disease. On the other hand, when the elevation of temperature is moderate, the duration of the maxima short, and the remissions early, we judge that the disease is of a mild type. Irregularities in the course of temperature, even when they indicate an abatement of the fever, are favorable only in special cases. A rise of temperature toward the end of this stage generally indicates some complication.

"The *amphibolic* stage is generally present in severe and in fatal cases. It is more plainly recognized after a regular fastigium. Its complications are ushered in by noticeable elevations of temperature. As long as it lasts, days or weeks, prognosis should be guarded. In it, a single very high or very low temperature is less significant than a steady one; a steady abnormal height threatens with relapse; moderately elevated it renders convalescence probable.

"The period of *defervescence* or cooling may directly follow the fastigium, or be separated from it by an amphibolic period, and a decrement stage. It is a return to the norm, and has two different types, taking place in from twelve to thirty-six hours by a rapid *crisis*; or gradually, the process occupying several days, by *lysis*. The march of the defervescence may be by a continuous fall, which, however, when it lasts more than twelve hours, is marked in the afternoon; or by a remittent fall, which is interrupted by evening exacerbations; collapse may supervene and protract the recovery.

The length of periods of access of fevers, *effervescence*; their continuance, *fastigium*; and decline, *defervescence*, present valuable prognostic bases:

SIGN.	SIGNIFICANCE.
Effervescence 2-3 hours, Fastigium 4-8 hours, Defervesence 2-4 hours;	an access of intermittent or other ephemeral fever.
Effervescence 2-3 days, Fastigium 4-8 days, Defervescence 1-3 days;	acute inflammatory diseases.
Effervescence 3-5 days, Fastigium 2-3 weeks, Defervescence 3-5 days;	typhoid fever.
Effervescence 3-5 days, Fastigium 2-4 weeks, Defervescence 3-7 days;	rheumatism and anomalous fevers.

Other valuable prognostications are: — Other things being equal, the danger is equal to the distance of the mean temperature from the norm.

A series from 104 degrees to 106 degrees prognosticate death in nine out of twenty cases.

If fever heat increases to its maximum slowly, it will decrease in the same ratio.

A great distance between the temperature of a morning remission and an evening exacerbation, is a favorable sign.

If temperature is of a continuous type, the affection is a grave one.

In children slight affections may give high temperatures; in the aged grave affections may give only moderate temperatures.

XIII. NOMENCLATURE OF DISEASE.

Diseases are named, when named according to any method, by an union of the name of the organ or tissue affected, and prefixes or suffixes, which indicate the character of the process, as:—

Inflammation, a prominent condition in a very large number of diseases, is expressed by the suffix *itis* added to the anatomical name; as, bronchitis, synovitis, pleuritis.

Flux, discharge or transudation from a mucous

surface, is expressed by the suffix *oea*; as, diarrhoea, leucorrhoea.

Hemorrhage, flow of blood from a mucous surface. adds *rhagia* to the anatomical name; as, metrorrhagia, pneumorrhagia.

Pain, without inflammation, is indicated by the suffix *algia*; as, neuralgia, gastralgia.

Morbid conditions of the blood take the ending *aemia*; as, septicaemia, putrid infection of the blood; pyæmia, purulent infection of the blood.

Morbid conditions of the urine take the ending *uria*; as, albuminuria, haematuria.

Dropsical conditions of organs prefix *hydro* to their names; as, hydrocephalus, hydropericardium.

XIV. THE PHENOMENA OF DISEASE.

Every case of disease demands from us the most careful and painstaking investigation. It is not always true that slight manifestations signify trifling illness, and tumultuous ones grave illness, and therefore every symptom and sign should be weighed by the standards of experience, or weighed to make up a standard of experience.

Symptomatology you will hear of in all places, at all times, and from all men. Every symptom has a meaning because it is a sign of suffering on the part

of the organism; and yet their value varies a great deal. Some are specific, pointing unerringly to conditions, while others are irrelevant, being merely signs of illness in general, and no more.

The term embraces all the appreciable phenomena of disease. Symptoms are *objective* when within the means of observation of the examiner; *subjective* when appreciated only by the patient and described by him. Symptoms are *general* when common to many disorders; *pathognomonic* when they are characteristic of or constant to any one disease. *Diagnostic* symptoms are of wider significance than the pathognomonic in the fact that they may be common to a number of diseases, but are characteristic of the class to which they belong. For instance, eruptions upon the surface are diagnostic of the eruptive fevers, while cupping of the eruption is pathognomonic of small-pox.

There are certain phenomena of disease that are always prominent, always important, always significant, and they refer to one or other of the vital systems or functions, and the chief of these are as follows:

1. *The circulatory or vascular system.*

This includes the heart, arterial, capillary and venous systems.

There are certain elements that are to be always borne in mind, whatever portion is the subject of

disorder. They are the conditions of the blood itself, its constitution and quantities; the condition of blood vessels, their tension, relaxation, or lesion; pressure or obstruction, in cephalic, pulmonary, portal, or systemic circuits; the heart itself, in organic or functional changes, primary or secondary; the nutrition of all and their nerve supply.

The normal fluctuations of blood currents and volumes are constant phenomena which are induced by a great variety of circumstances, such as physical exertion, digestion, emotion, temperature, besides all sorts of external conditions. So that in abnormal conditions the currents and volumes of the blood have come to have a very high estimate placed upon them as indications of what is taking place within the body.

Disturbances of circulation are local or general. Those local are usually the result of local injury or disease. General disturbance affects the whole or great parts of vascular areas. In the latter it may remain a question whether it is caused by disturbed function of the heart, disease of blood vessels, or the character of the blood itself.

It must be estimated how the blood is being distributed, and why improperly distributed. The cavities of the heart, which must transmit equal volumes; the arteries, which may lose contractile power; the capillaries, which may be obstructed or obliterated;

and the veins, which may be distended or occluded by thrombi, must at all times be responsible for unequal distribution of blood, and thus various congestions, engorgements and anaemias have their origin.

The *pulse*, the impulse against the examining finger of an artery of known caliber, as at the wrist, is a guide to these conditions. Blood flowing through an artery of known caliber gives to the finger a certain impulse in health, and variations from this healthy impulse constitute its characteristics in disease. It corresponds with the systole of the heart. The pulse is modified by the condition of the heart; by the contractility and tonicity of the arterial tubes; by the caliber and permeability of capilliaries and veins; by the character of the circulating fluid; by conditions of nerve supply; and by the conditions of other systems. To intelligently appreciate all these modifications the pulse in health should first be carefully studied.

A *normal* pulse is regular, both as to movement and interval; it is vigorous, that is, the vessel is completely distended, but is yet soft, firm, and elastic, without being tense and cord-like. Its average rate per minute is, for adults, about 70.

The *fast* pulse may be due simply to nervousness; is found in fevers and inflammations; is very fast in dilatation of the left ventricle, and in overdistension of the right ventricle; is of bad omen in

pulmonary affections according to rapidity; is more and more rapid in advancing exhaustion. In chronic disease it is of great prognostic importance. In phthisis, for example, a persistently frequent pulse marks proportionately advancing disease; indeed, all other symptoms, hectic, cough, expectoration, are of quite secondary importance in comparison with it. The same rule is measurably good in all chronic diseases. Bear in mind the distinction between the fast or frequent, and the *quick* pulse. The latter results from quick filling of a slack artery, and the sensation imparted is that of sharp and sudden filling of the vessel, and its sphygmographic tracing is higher than that of the fast pulse. Its significance is loss of resistance from lowered arterial tension, which may depend upon loss of inhibitive nerve force or exhaustion.

The fast pulse may have still another quality; it may be *tense*. In the tense pulse the vessel is appreciably contracted; the pulsations are rapid as a rule; the impulse is hard and unyielding; the whole giving the impression of abnormal resistance to the blood-current. It is characteristic of obstructive and toxaemic conditions, and is usually present in diseases of blood vessels, in kidney affections, and is a reliable premonitory sign of puerperal eclampsia.

The *slow* pulse does not indicate weakness, ex-

cept, perhaps, such structural weakness as is found in fatty degeneration of the heart. Otherwise it indicates torpor or idiosyncracy. A normal slow pulse is not rare, and is sometimes characteristic of a family. The slow pulse of torpor may occur in jaundice, in chronic Bright's disease,and in fatty and senile degeneration of the heart, and may follow malarial fevers.

The *pulse of high tension* is tight, hard, incompressible, and communicates to the finger the impression of long impulse; that is, as if the force exerted was exercised for a longer time in order to overcome unusual resistance. Or it may be described as a *pushing* pulse. It is a deceptive pulse, however, for it may be large or small, depending mainly on the condition of the heart, which may be vigorous or in a state of exhaustion. It is usually slow. The pulse hard in another sense, is found with material changes in the arterial walls, as in sclerosis and calcareous degeneration.

The *bounding* pulse is the full round pulse of inflammation, indicating vascular excitement with undiminished tone. It occurs in such diseases as pleurisy and pneumonia.

The *pulse of low pressure* is characteristic. An unequivocal sign is that no sense of resistance of the artery between the beats is imparted to the examining finger. It may show various forms of dicrotism,

or be tricrotic, or monocrotic. The impulse is usually great, owing to relaxation of the vessels. The cause of the dicrotic pulse, and all such variations, is that the small arteries and capillaries are in a state of relaxation which allows the blood to pass readily without resistance. The monocrotic pulse is more often found in fever. It is rapid, indicates very low tension, the recoil wave due to resistance being too weak to be reflected from the aortic valve. The pulse of senile life is essentially of the same character. The diseases in which such conditions are usually found are arterial, especially such as are accompanied by degeneration, atheroma; certain valvular diseases of the heart, especially such as are accompanied by great prostration; some cases of anaemia, more especially if congenital; and in fevers, if long continued and prostrating.

The *wiry* pulse is characteristic of inflammation of the abdominal viscera. The muscular coat of the artery is contracted, and the vessel feels small and hard. The more rapid such a pulse, the worse the case.

In the febrile state, in general, the pulse is increased in frequency, and is usually diminished in force; it may be either hard, full and bounding, or tense, small and contracted. The former is more common in active inflammation of organs above the diaphragm and the latter in inflammations below the

diaphragm, and in idiopathic fevers. In fevers of typhoid type an unusually slow pulse is sometimes encountered, and also the dicrotic pulse. In the later stages the pulse may be soft, gaseous, thready, indicating febrile changes in the walls of the vessels and heart.

Infrequency, irregularity, intermittency, and palpitation, are disturbances often met with and often difficult to explain. Some of the more common causes of them may be mentioned.

Infrequency occurs in convalescence from acute diseases; in increased arterial tension; in jaundice and after injuries to the head. It is met with in encephalitis, meningitis, cerebral abscess and hemorrhage, and in some grave heart diseases.

Intermittency may be unimportant or of grave significance, gravity depending on the tension of blood vessels. High tension pulse with intermittency is more serious than the reverse, it being probably significant of progressive damage to valves and coats of the aorta. If intermission occurs only after exertion it is of graver import than if constant. More frequently it means some bad habit, as overwork, excess in tobacco, tea and coffee; or may be induced by shock, grief, anxiety, etc.

Irregularity is made up of irregular rhythm and inequality of tension. The pulse is irregular in force and volume. It may arise in the bad habits referred to, or cardiac disease, and its prognostic value de-

pends on the latter. It is among the early indications of brain disorder in young children.

Palpitation, a form of irregularity, if persistent, denotes profound nervous disorder, and tends to heart failure. The nervous or organic origin of palpitation may be determined by causing the patient to exert himself. Extra exertion subdues the rapid action if of nervous origin, while a contrary effect ensues if of organic origin.

2. *The Digestive System.*

This system includes mouth, stomach, liver and its appendages, pancreas, and intestines. Disorder is shown by alteration of parts; by derangement of functions; by pain or discomfort; and by altered secretions and excretions.

Probably no organ or tissue within observation presents so many, so constant, and such characteristic signs of disease, as the *tongue*. It being in continuation with the alimentary canal, it may be supposed to reflect the conditions of the organs concerned in the function of digestion, and does so very constantly. However, a furred tongue is not always a sign of bad health. In rare cases a coated tongue is always present, the health good. Smokers may have a coated tongue in the morning, a mere local epithelial condition. It is present in many general conditions where it has no special significance, and therefore its appearances may be

deceptive, requiring skilled observation to read the meaning.

When gastric and intestinal secretions are deficient, from inflammatory irritation, the tongue assumes a fiery redness, and is pointed, hard, and dry. When the secretions are abundant and vitiated, it becomes soft and swollen, and an offensive mucus covers it and lines the mouth.

In atonic dyspepsia the tongue has a pretty uniform white coating, usually with constipation. If with the same coating there is malaise, languor, and chilly sensations, a fever or acute inflammation may threaten. A uniform white coating which gives the tongue the appearance of having been painted, is described as the malarial tongue. If the tongue has a yellow stain but is otherwise clean, the liver is disordered. A yellow or brownish fur along the middle of the tongue in the morning, with hot and bitter taste, means the same thing. The patchy or map-tongue is most frequently found in children, and most often indicates partial inflammation of the stomach. The red and dry tongue is found in brain fevers, and in thoracic and abdominal inflammations; red and dry at tip and edges, or through the center, indicates the typhoid state, or transition into it; red and smooth, with projecting papillæ, the strawberry tongue, is seen in scarlet fever. Tremulous protrusion of the tongue indicates exhaustion or extreme nervousness.

My own experience has led to the following classification of conditions of the tongue, as they indicate conditions of the digestive tract. There are three types.

1.—The *irritable* tongue. It is more pointed and redder than normal, and may even look raw, especially at tip and edges where the papillae stand out as vivid red points. It indicates irritation and hyperaemia of the mucous lining, from whatever cause.

2.—The *flabby* tongue. It is broad, pale, and flabby; the papillae may or may not be enlarged; it is wet, sodden, and takes the imprint of the teeth. It indicates atony of the stomach, of all its structures.

3.—The *mixed* tongue. It appears moist, sodden, swollen, and perhaps pale, but also has red tip and edges, and enlarged papillae, thus combining the two types just mentioned. It may have a pretty uniform thick white or brownish fur.

However, too much emphasis is liable to be placed upon the coating of the tongue, and too little upon its substance. The coating is very often a mater of insignificance, while the substance is never so. The exfoliation of the epithelium of the tongue proceeds constantly, more or less rapidly according to other conditions. Normally, the detached scales are brushed off the points of the papillae by the mo-

tions of the tongue, and by food, drink, or whatever passes through the cavity, and thus it is kept clean. When sick the case is different. Exfoliation is more or less rapid; the tongue moves less; less food and drink may be taken; all sorts of matters become mixed with the scales not carried off and vitiated mucus and saliva, and thus the mass accumulates and remains as a coating. If the patient has fever, the coating becomes dry, may crack, and is thick and tough and the tissue beneath is degraded as in typhoid fever, the tongue itself may crack and bleed, and thus cause the black, bloody coating. Breathing with open mouth changes the color of the coating from white to brown, from contact of air, and thus it becomes dry and brown.

Therefore give the most careful attention to the substance of the tongue.

The under surface of the tongue presents certain points of diagnostic significance, in connection with the superficial ranine vessels. In the young and healthy the veins only are seen beneath the mucous membrane, but in advanced life, or in disease, they become varicose and tortuous, and the venules and capillaries are visible. Such varicosities may be minute or so large as to be easily seen as little projections the size of millet-seeds. They may be few and scattered, or numerous and grouped like a bunch of grapes. They are usually found near the

tip or root of the tongue and on either side of the median line. Their color varies from bright red to purple or black.

They are true miliary aneurisms, and are analogous to the same formations on cerebral vessels. In fact, the formations under the tongue are diagnostic of the same formations in the brain. Examination of the fundus of the eye furnishes no truer indication of the conditions of cerebral vessels than the under surface of the tongue, both for the same reason. The latter has the advantage of not requiring expert knowledge for the examination.

In many forms of disease derangements of the digestive organs arise sympathetically, and are therefore not an essential part of the disease. Very general manifestations of this sort are: pain, loss of appetite, oppression, nausea and vomiting. These occur not only on account of abnormal conditions of the stomach itself, but also in fevers, brain and nervous troubles, abdominal and uterine disorders, and many others. The greatest care is, therefore, necessary to distinguish the cause and relation of symptoms; whether they are organic, or functional, or sympathetic.

3.—*The Respiratory System.*

Dyspnoea, difficult breathing, may be continuous or paroxysmal; may arise from muscular debility, mechanical obstruction, spasm, or disorganization.

Especial slowness or hurry in breathing in fevers, particularly in protracted fevers, should be noted. The first may indicate oppression of the brain or exhaustion. The second may indicate implication of pulmonary tissues, as, congestion, or changes in the mucous surfaces; or if it occurs in connection with increasing rapidity of the heart's action, it indicates rapidly advancing exhaustion.

Yawning and sighing are signs of imperfect circulation through the lungs. They are present in the cold stage of all fevers, and mark the congestive forms so often fatal.

Cough and expectoration are often quite characteristic. You will learn by experience and observation what is difficult to describe, to distinguish laryngeal, bronchial, or lung coughs, by the sense of hearing; and by appearances to the eye to trace the various kinds of expectoration to their origins. A croupous child, a tuberculous adult, an asthmatic, and the subject of senile catarrh carry their cough notes with them. Inflammatory conditions and morbid deposits are shown by the expectoration.

4.—*The Sensorial System.*

As a rule morbid alterations of structure or function imply pain. Pain varies in kind and intensity according to susceptibility of the patient, to the tissue in which it is seated, and to the intensity of the disease. Pain generally refers to the seat of

the disease, but may not; exceptions are numerous. For example, an inflamed liver causes pain at the top of the shoulder; when the hip-joint is diseased the pain may be at the knee; the presence of a calculus in the kidney, or when it is traversing the ureter, will cause pain in the urethra and testicle; a gall-stone in the duct will cause pain in the stomach; hepatic irritation will cause a most harrassing cough; a nerve irritated at its origin or along its course, will cause pain in the region of its distribution; and so on in many instances.

Pain differs in character in different tissues, probably by virtue of their intimate structure. Serous tissues suffer very acutely; mucous tissues and the parenchyma of organs acquire a dull pain or distress, or the mucous tisue may yield a burning or smarting pain. The character of pain inside or outside of an organ is often quite characteristic; as, in cerebral diseases pain in the meninges, or investing membranes, is exceedingly acute; while in the brain substance it is heavy and oppressive. In hepatic inflammation, if the coverings are involved the pain is acute; if the parenchyma, it is dull. If the lining membrane of the stomach or intestine is inflamed it may proceed, especially in the presence of a disease like typhoid fever, to an almost fatal extent with little or no pain; while if the serous investment of either is involved, the pain becomes agonizing.

There is a wide range of variations of common sensation. In one case the cutaneous sensibility may be so increased that a slight touch becomes exquisitely painful, *hyperæsthesia;* in another it may be so decreased that even the touch of hot iron may be unperceived, *anæsthesia;* or in various ways sensation may be abnormal; as, the hot may feel cold, or cold hot, *paræsthesia.* As a rule these conditions are due to diseases of brain or cord. They may be hysteroidal or reflex.

5.—*The Motor System.*

Muscles and joints are liable to specific modes of disorder. Rheumatism is an inflammatory affection of them which gives rise to permanent tumefaction and induration, resulting in irregularities and deformities. A deposit of earthy matter in the joints is seen in gout. Among the most important affections of these organs are those associated with nervous functions, such as paralysis, spasm, cramp, and convulsion. Paralysis depends upon cutting off the nerve supply of the part, and may have its origin in brain or cord; if in the brain the motor loss is on the side of the body opposite to the lesion; if in the cord, the loss is most often on both sides of the body. Convulsions depend on irritation of the brain cortex, from whatever source. Cramps and spasms are local effects of perhaps the same sort of irritation, that from some cause do not become general.

XV. DIAGNOSIS.

Diagnosis consists in naming the seat and character of an abnormal process, and in its discrimination from other abnormal processes.

In view of the foregoing it is seen that it may often be a laborious process to establish a diagnosis. To say nothing of general diagnosis which determines the form of disease and gives it name and place, our methods of treatment require special diagnosis, that is, individualization of every case; to know all its elements and relations and complications, predisposing, proximate, or accidental. Otherwise we are confused or misled by lapses in the lines of continuity in disease-picture, or drug-picture, or both, which should be parallel.

The ability to diagnose disease presupposes a knowledge of parts and functions in health. For instance, how may one recognize abnormal sounds in the chest if he does not know the normal sounds; how determine an abnormal urine if he does not know the normal? Again, one must be able to relate certain constant symptoms with certain constant causes. Not all symptoms have constant relations. Those that are so definite are the same that we call "characteristic" or "key-note" symptoms when speaking of a remedy, and are so impor-

tant to discover because they are characteristic or diagnostic of the disease or condition, just as in the other case they are diagnostic of the remedy.

It is here that the parallel arises that was spoken of a moment ago. Many other symptoms occur, some that tend to confirm the diagnostic, some that merely reflect others, some sympathetic, some imaginary, and a host that are irrelevant. The skillful diagnostician must classify these, which often taxes his ingenuity and knowledge to the utmost.

The different classes of symptoms are already known, as the subjective, objective, diagnostic, and pathognomonic. The objective are further divided into *symptoms* and *signs*. It is remembered that objective symptoms are those obtained by the examiner without the aid of the patient; as, cough, heat, cold, secretions, excretions, appearance of eyes, tongue, skin, etc. Signs are objective, but they are demonstrable structural changes, demonstrable by exercise of any special sense of the examiner, and by the use of various devices. Thus, the "physical signs" of pulmonary and cardial diseases are proofs of structural changes in these organs; microscopical and chemical conditions of urine are proofs of kidney and blood changes; and the laryngoscope, cystoscope, speculum, etc., reveal signs of disease in organs brought into view by them.

Another distinction is recognized, the *rational*

signs. The subjective and objective symptoms and signs being taken into account, the logical deduction from them gives the results of deranged functions. For example, the logical deduction based upon such an array of signs and symptoms as this, dyspnoea, vertigo, weakness, pale or livid face, palpitation on slight exertion, and dropsical effusion, is that there is valvular disease of the heart; and the deduction is verified by the physical signs, determined by auscultation and percussion.

Now let us put all these definitions into a series:

A *symptom* is a manifestation of disease.

An *objective* symptom is within the means of observation of the examiner.

A *subjective* symptom is appreciated only by the patient and is described by him.

Diagnostic symptoms are characteristic of a class of diseases.

Pathognomonic symptoms are constant to a single disease.

A *sign* is a demonstrable structural change.

A *rational* sign is a deduction based upon an assemblage of subjective and objective symptoms and signs.

A *physical* sign is one obtained by special means of exploration; as auscultation, percussion, palpation, inspection and mensuration; chiefly used in examinations of thorax and abdomen.

To make a clear diagnosis, one to be substantiated to a brother practitioner, it is to be supposed that the *natural history* of the patient has been taken, including the family history, its predispositions, traits, temperaments; the *clinical history*, including predisposition, diathesis or cachexia, etiology, and course to the time of examination; all of the symptoms and signs in detail, carefully discriminating those that are essential to clear the case; then how to interpret the whole assemblage of symptoms and signs; that is, how to make a diagnosis?

1. "The *inductive method.* Reasoning upon anatomical and physiological data, the character of the disturbance should point to the organ affected and the nature of the affection.

2. "The *historical* or *empirical method* is based upon the records of others and one's own experience that certain symptoms manifested under certain circumstances indicate a certain malady.

3. "The *method of pathological association* is based upon the fact that when certain symptoms have been observed during life, definite lesions are discovered after death."

It is at once seen that the use of all the methods is likely to yield the best results, for each becomes, as the case may be, a check upon or proof of the other. For instance, simple *induction* in a case of vomiting might lead to the belief that the stomach is

at fault; but *empiricism*, one's own or another's experience, introduces the check that it may be caused by irritation of the brain; while *pathological association* proves, in case of death, that it is the brain or stomach, as the case may be.

Diagnosis is also *direct*, *differential*, and *by exclusion*.

It is said to be *direct* when, independently of any other symptoms or related conditions, one or more symptoms or signs point at once to the nature of the disease. The onset of intermittent fever, pneumonia, and dysentery are examples of this.

It is said to be *differential* when the symptoms and signs and relations point to two or more diseases when compared. This, in the nature of things, is that most commonly employed, for the simple reason that but few sicknesses admit of direct diagnosis; they are mixed, or obscured by reflex, secondary, or irrelevant symptoms. It is an appeal to differences.

In diagnosis *by exclusion*, the case presents no direct symptoms, and differentiation leads to doubtful conclusions, when there must come an appeal to negatives; that is, the ideal conditions or characteristics of diseases that resemble the case in hand are found to be absent. So that "from the absence of what ought to be present and the presence of what ought to be absent, one after another of the conditions discussed is set aside, until finally one remains

that cannot be so excluded; and there is reached the probable diagnosis."

As experience extends the negative symptoms take on considerable importance. Thus, no persistent headache, no brain tumor; no albumen and casts in the urine, no Bright's disease; no eruption, no typhoid fever; no rusty sputum, no catarrhal pneumonia; no loss of knee-jerk, no locomotor ataxia, and the like. However, one should be guarded against masked or exceptional cases.

To arrive at this information the patient and his friends are to be subjected to rigid inquiry, and the powers of observation are to be cultivated to their highest point; for there come into our hands malingerers, the victims of sicknesses that do not exist; those who intentionally deceive, as well as the honestly sick. But with all the safeguards and checks and proofs that all of these means possess us of, it should be made a part of our very selves that it is not a safe diagnosis that does not take cognizance of and account for every symptom. At the best there are too many instances where failure follows the best endeavor;—but let it be after the best endeavor.

Above all, make a diagnosis with care; spare no pains to have it correct. There is dash and brilliance in rapid diagnosis; it may be true; but if not! There is always lasting reputation in pains-taking accuracy; there is always lasting reputation for the physician who does not make mistakes.

Be, therefore, reliable diagnosticians!

XVI. PROGNOSIS.

Prognosis is a statement embracing the course, duration, and result of a disease; it is foreknowledge of events based upon previous and present conditions.

If based upon experience or observation only, regardless of the nature and reasons for results, it is called *empirical* prognosis. That is to say, a certain group of symptoms has been generally followed by recovery; or a certain other group by fatal issue.

If based upon an estimate of the nature, course, and tendency of the disease, and the power of treatment over it, it is called *rational* prognosis. In this case, as in that of diagnosis, the precise value of every cause and condition is sought to be estimated. For instance, in a case of typhoid fever, having by exercise of rational methods ascertained the cause, seat, and character of the affection, the practitioner at once, and by the same methods, undertakes to estimate the damage already done and to be done, in order to form a provisional opinion as to the result. To this end he carefully examines the conditions of all vital centers, respiratory, circulatory, nervous, digestive; the secretions and excretions; the rhythm of the disease, including rise and fall of temperature, respirations, pulsations; the signs of

degeneration or disorganization of tissue, as shown by toxic and septic phenomena; and in general strikes a balance between the forces remaining, and those to be yet lost, and thus arrives at a rational estimate of the end. Nor does he lose sight of such possible complications as profuse hemorrhages, exhausting diarrhoea, and prostrating sweat; nor forget the unconsciously murderous zeal of the blundering nurse who feeds his starving friend; but all in all renders judgment founded upon every rational ground at his command. Empiricism teaches him that the average case or one presenting certain symptoms, lives; another with certain other symptoms, dies; a system of good symptoms and bad symptoms. Rationalism admits both good and bad symptoms, but renders a reason for either. It foresees, and therefore anticipates and possibly mitigates or prevents complications.

What does it all mean? Look backward for a moment and see. We have found many things that under various circumstances become predisposing and exciting causes of disease, such as age, sex, occupation, habits and environment; that constitutional traits and conditions and tendencies modify diseases, determine their character, intensity, and results—such as temperaments, diatheses, cachexiae, previous and present disease; that symptoms are not always proportional, are elusive and delusive and

irrelevant, as well as direct and diagnostic; that all things that go to make up causes, nature, seat, course, and results of disease, are all requisite for diagnosis. Then to all this is added the results of observation, experience, reason, judgment, the power to compare, weigh, justify, and relate, the sum of which is that foreknowledge called *prognosis.*

In the main, prognosis is based upon, first, circumstances relating to the patient; and second, those relating to the disease; as follows:

Age of the patient. Acute diseases are not borne well by either the aged or children, because both have low resistance, and reaction is less energetic. In children these diseases are often fatal; in the old they tend to assume the chronic form.

Sex of the patient. Nervous diseases are more common and more tenacious in females; they are more serious, and more apt to be of degenerative type in males. Menstruation may be a favorable, and its suppression an unfavorable sign. Pregnancy and lactation arrest the progress of tuberculosis, which breaks out afresh when they cease. The eruptive fevers are peculiarly fatal to pregnant and lying-in women.

The temperament of the patient. In the sanguine temperament or diathesis diseases are apt to be acute, severe, terminating rapidly one way or another. In the lymphatic, diseases are of less inten-

sity, tend to become chronic, and are often obscure. In the nervous the symptoms are prominent and urgent, cause great suffering, change frequently, and may often appear alarming when no real danger exists.

Previous disease of the patient. In some diseases, as in the eruptive fevers, subsequent attacks are milder; in others, as in apoplexy, neuritis, rheumatism, the tendency to recurrence increases, and with it the danger of each succeeding attack. Albuminuria and dropsy, if post-scarletinal, are more amenable to treatment than when they arise from other causes. Heart disease is a frequent sequel of rheumatism. Paralysis following diphtheria, scarletina, and other zymotic diseases, is often very intractable.

Present disease of the patient. The subjects of carcinoma do not become tuberculous, and inflammations in them are rare. Emphysema of the lungs precludes tubercular formations and other parenchymatous diseases, but predisposes bronchial surfaces and liver to congestion and inflammation. Infectious disorders and fevers are particularly fatal in those who have diseased hearts, lungs, kidneys, or brain. And in general, old structural diseases intensify and render intractable any new disorder.

Previous habits of the patient. The habitual use

of alcoholic beverages and other excesses increase the danger of all sicknesses, and especially of accidents. Exhausting occupations, privations, confinement, loss of sleep, not only predispose to disease, but increase its severity and danger, because resisting and reacting powers are already below the normal standard.

Condition of the patient at time of the attack. We speak of bad subjects for disease;—for instance, weakness or exhaustion from any cause are bad conditions to begin with; the obese are bad subjects; business worry or other mental or emotional excitement, are apt to add a dangerous element to fevers.

Location and nature of the disease. Epidemics of disease vary in intensity in different years and in different localities; hence cases are serious according to the type of the epidemic. As to the part attacked, the more important it is to life the more the danger. The heart, medulla oblongata, kidneys, blood and blood vessels, present great risks if the attack is extensive. An attack upon an unimportant part may later involve one that is vital; as, extensive burns of the skin may involve the kidneys to a dangerous extent.

Extent and progress of the disease. The greater the extent of the disease, generally, the more serious it will be, if the case be one of inflammation. But sometimes the severity of the symptoms is not in

proportion to the extent of the mischief, as, intense and circumscribed inflammation causes more marked symptoms than that which is extensive and diffused. The rate of progress of the disease is important, for while in one case structures may be diseased to an extraordinary extent if the advance has been gradual, in another a fraction of it would be fatal if induced suddenly.

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